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9004B

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DESCRIPTION: CHANNEL BANK	
MANUFACTURE: SIEMENS	MODEL: 9004B

CALIBRATION REQUIREMENTS

SOURCE: ERS FT. WAYNE	TAR=> N/A	CALIBRATION/TEST INTERVAL: 12 MONTHS

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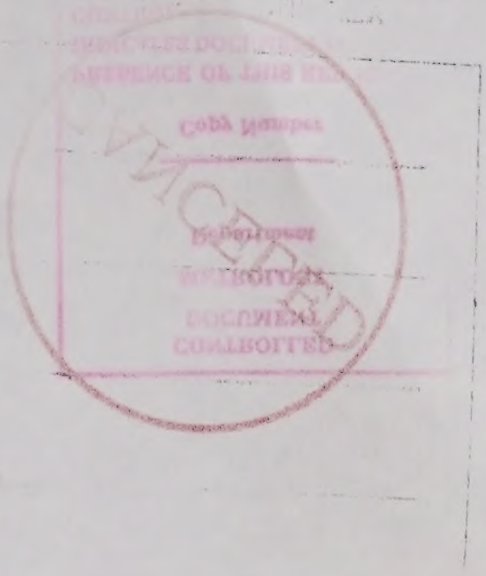

STANDARDS LIST

NOTE: The equipment list below reflects the STANDARDS recommended by the calibration procedure of the UUT. Deviations from the recommended STANDARDS will be documented on this sheet.

UUT:

RECOMMENDED STANDARDS	STANDARDS USED

REMARK: Calibration personnel are responsible to verify compliance to QUALITY ASSURANCE and IMPROVEMENT MANUAL QM0001 Paragraph 4.4 Document Number P4040005 Section VI and Paragraph 4.10 before use.

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9004B PCM Channel Bank - System Manual

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Part No.: 980-91006-00

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Section 342-911-133
Issue 2, September 1990

9004B

PCM Channel Bank
Functional Operation, Engineering, and Ordering Information

This practice has been prepared for those who operate and maintain the equipment manufactured and sold by Siemens Communication Systems, Inc. The information in this practice is subject to change and may not be suitable in all situations. Siemens Communication Systems, Inc. acknowledges that a customer's special requirements or practices may take precedence over those supplied in this practice if a conflict develops during installation or ongoing operation. Siemens Communication Systems, Inc. hereby disclaims any responsibility or liability for any consequential or inconsequential damages that may result from the use of this practice.

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ESDS CAUTION

As the electronic industry uses lower power and higher-density equipment packages, the components have become more and more susceptible to damage from electrostatic discharge. In such cases, Siemens Communication Systems, Inc. designs the equipment to minimize the possibility of failure resulting from electrostatic discharge. The units and their shipping containers are marked with the Electronic Industries Association (EIA) symbol (see below) for ESDS devices. For enclosed units, the case as well as the unit is identified with the EIA symbol. Handle these units according to your company's procedures or refer to Sections 300-000-001 and 200-910-200.

EIA Symbol

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TECHNICAL SUMMARY

VF Channels (*)

Number	48	
Levels (see Tables 6, 17 and 18 for adjustment ranges)		
Two-wire	0 dBm transmit; – 3 dBm receive	
Four-wire	– 16 dBm transmit; + 7 dBm receive	
VF level stability (20 years, 95% of circuits)	+ 0.5dB of reference loss	
Bandwidth (loss relative to 1-kHz loss)	2W to 2W	4W to 4W
200 Hz	0 to 5 dB	0 to 3 dB
300 to 3000 Hz	– 0.5 to + 1 dB	-0.3 to + 0.3 dB
3200 Hz	1.5 dB max	1 .5 dB max
3400 Hz	0 to 3 dB	0 to 3 dB
Impedance		
Two-wire	600 or 900 ohms plus 2.15 µF	
Four-wire	600 ohms	
Two-wire return loss		
ERL (weighted)	28 dB minimum	
SRL (weighted)	20 dB minimum	
Interchannel crosstalk	Less than 25 dBrnc0	
Idle noise (all channels terminated)	23 dBrnc0 maximum	
Impulse noise,digital loopback; drops not connected		
	Threshold level	Maximum counts in 30 minutes
	41 dBrnc0	10
	51 dBrnc0	1
	58 dBrnc0	0.1
End-to-end	58 dBrnc0, maximum 5 counts in 5 minutes	

*Refer to Sections listed in Table 1 for additional VF and signaling specifications of particular channel unit types.

TECHNICAL SUMMARY (Continued)

Digroup Signal		
Superframe (SF):		
Frame organization	24 eight-bit channel PCM words plus one framing bit (193 bits total)	
Channel PCM word (12-frame interval)		
Frames 1 through 5	Eight VF information bits	
Frame 6	Seven VF information bits and one "A" signaling bit	
Frames 7 through 11	Eight VF information bits	
Frame 12	Seven VF information bits and one "B" signaling bit	
Framing bit pattern (12-frame interval)		
Terminal framing bit	101010 in odd-numbered frames 1 through 11	
Signaling framing bit	001110 in even-numbered frames 2 through 12	
Signaling on VF channels		
Signaling channels	Two (A and B)	
Bit rate	1333 b/s (666 b/s on A and B)	
Combo/Coder-decoder (CODEC)	Per-channel type; approximates μ-255 companding law	
Channel sampling sequence	D1D, D2, or D3/D4	
Timing	Modes 1 and 2	Mode 3
Clock frequency	1.576 MHz	1.544 MHz
Channel sampling rate	8000 Hz	8000 Hz
Bit time slot	634 ns	648 ns
Channel PCM word (8 bits)	5.07 μs	5.18 μs
Frame	125 μs (197 bits)	125 μs (193 bits)
Compatibility	End-to-end compatible with AT&T D3/D4 type channel banks (Modes 1, 2, and 3)	

TECHNICAL SUMMARY (Continued)

Digroup Signal (Continued)	
Extended Superframe (ESF): (91418 Unit only)	
Frame organization	24 eight-bit channel PCM words plus one framing bit (193 bits total)
Channel PCM word (24-frame interval)	
Frames 1 through 5	Eight VF information bits
Frame 6	Seven VF information bits and one "A" signaling bit
Frames 7 through 11	Eight VF information bits
Frame 12	Seven VF information bits and one "B" signaling bit
Frames 13 through 17	Eight VF information bits
Frame 18	Seven VF information bits and one "C" signaling bit
Frames 19 through 23	Eight VF information bits
Frame 24	Seven VF information bits and one "D" signaling bit
Framing bit pattern (24-frame interval)	
Terminal framing bit	001011 in framing bit position of frames 4, 8, 12, 16, 20, and 24.
CRC bit	In framing bit position of frames 2, 6, 10, 14, 18, and 22.
Message channel framing	In framing bit position of odd-numbered frames
Signaling on VF channels	
Signaling channels	Four (A, B, C, and D)
Bit rate	1333 b/s (666.6 b/s on A and B)
Combo/Coder-decoder (CODEC)	Per-channel type; approximates μ-255 companding law
Channel sampling sequence	D3/D4
Timing	Mode 3
Clock frequency	1.544 MHz
Channel sampling rate	8000 Hz
Bit time slot	648 ns
Channel PCM word (8 bits)	5.18 μs
Frame	125 μs (193 bits)
Compatibility	End-to-end compatible with AT&T D3/D4 type channel banks (Mode 3)
Craft Interface:	
RS-232-C	1200 Baud, 8-bit (two XMT stop bits, no parity)
RS-422	2400 Baud, 8-bit (one XMT stop bit, no parity)

TECHNICAL SUMMARY (Continued)

DS1 Interface (Mode 3)	
Line rate	1.544 Mb/s ± 130 b/s (91438/91439) ± 130 b/s Sync (91418 only) ± 32 b/s Source (91418 only)
Line code	Bipolar AMI B8ZS (B8ZS 91418 only)
Transmit pulse characteristics	
Base-to-peak height	6 volts ± 10% into a cable equalizer
Unbalance in height of positive and negative pulses	± 0.3 volt
Half-amplitude width	324 ± 30 ns
Unbalance in width of positive and negative pulses	+ 15 ns
Maximum rise or fall time	80 ns
Minimum density	Normally 1 in 8; not more than 15 consecutive zeros
Receive pulse amplitude, base-to-peak	1.5 to 3.3 volts
Pulse characteristics at DSX-1	
Amplitude, base-to-peak	3.0 volts nominal
Width at 50% amplitude	324 ± 30 nanoseconds
Power ratio,positive to negative pulses	Less than 0.5 dB
Line impedance	100 ohms nominal
Maximum GTS-8510 or ABAM cable length to DSX-1	655 feet
DS1C Interface (Modes 1 and 2)	Supported by 91438 and 91439 units only
Frame organization	
Mode 1 (pseudo M1C)	Two interleaved synchronous digroup signals plus an eight-bit pattern of framing bits (394 bits total)
Mode 2 (M1C)	Two interleaved asynchronous digroup signals plus a 24-bit pattern of control bits (1,272 bits total)
Signal statistics	Average pulse density at least 1 in 8 over 130 consecutive time slots
Line rate	3.152 Mb/s + 30 ppm
Line code	Bipolar

TECHNICAL SUMMARY (Continued)

DS1C Interface (Modes 1 and 2) (Continued)	
Pulse amplitude,base-to-peak	
Transmit output	6 volts + 10% into a cable equalizer
Receive input	1.7 to 3.3 volts
Pulse characteristics at DSX-1C	
Amplitude,base-to-peak	3.0 volts nominal
Width at 50% amplitude	160 + 20 nanoseconds
Power ratio,positive to negative pulses	Less than 0.5 dB
Line impedance	110 ohms + 5% balanced
Maximum GTS-8510 or ABAM cable length to DSX-1C	200 metres (655 feet)
Input Power	
Voltage	44 to 56 volts dc (48 volts nominal)
Current to a fully-equipped channel bank (*)	
With 48 E&M channel units	1.0 ampere
With 24 DPO and 24 DPT channel units	1.5 amperes plus loop currents
Environment	
Ambient temperature range	0 to 50°C (32 to 122°F)
Maximum relative humidity	95% noncondensing at 40°C (104°F)
Maximum operating altitude	15,000 feet
Maximum heat dissipation:	500Btu/h (watts input power × 3.413 = Btu/h.
Physical Arrangement	
Rack mounting	Standard 19" rack; 14" overall depth with 5" forward projection from rack mounting surface
Mounting spaces, 44-mm (1-3/4-inch)	12-space shelf plus an optional 1- space ventilation baffle
Weight,fully equipped	80 pounds maximum

TECHNICAL SUMMARY (Continued)

Equipment	Weight (lb)	Dimensions (Inches) high x wide x deep
91418 Transmit and Receive ESF Unit	0.75	4.75 x 1.00 x 11.75
91419 ESF Remote Performance Interface Unit	0.8	4.75 x 1.25 x 11.75
91420 Alarm Control Unit	0.6	4.75 x 1.25 x 11.75
91425 Power Supply Unit	3.5	4.75 x 3.25 x 11.5
91426 Syndes Unit	0.8	4.75 x 1 x 11.75
91427 Line Interface Unit	0.4	4.75 x 0.7 x 11.75
91430 Terminal Equipment Shelf	25	21 x 17.3 x 14
91436 Power Distribution Unit	3.1	4.75 x 3 x 11.75
91438 Transmit Unit	0.4	4.75 x 0.5 x 11.75
91439 Receive Unit	0.4	4.75 x 0.5 x 11.75
91445 Signaling Path Test Set	1.2	4.75 x 1 x 11.75
91448 Office Interface Unit	0.8	4.75 x 1 x 11.75
Channel unit (typical)	0.9	4.75 x 1 x 11.38
5215B Miniature Jackfield Assembly	5	
56620 Writing Shelf	5.5	
91455 Fuse and Alarm Panel	5	
9140A Digital Test Set	23	
91232 Test and Alignment Set	14	
91442 VF Test Set	12.8	4.88 x 16.25 x 9.1
91443 Test Patch Panel	1.6	

Siemens Communication Systems may change performance specifications where necessary to meet industry requirements.

1. GENERAL

1.01 This Section is a general description of the 9004B PCM Channel Bank and associated equipment, and includes engineering considerations and ordering information. The 9004B is a PCM trunk carrier terminal with a digital input/output of two 24-channel DS1 signals or one 48-channel DS1C signal. It may be used for direct, tandem, toll-connecting, and intertoll applications.

1.02 This Section is being revised to add information on the new ESF common equipment options. The ESF common equipment includes a new 91418 Transmit/Receive ESF Unit and 91419 Remote Performance Interface Unit. The 91418 unit replaces the existing 91438 Transmit and 91439 Receive Units. The 91419 replaces the existing 91448 Office Interface Unit. Because the changes have been extensive and the section has been put into a new format, changes have not been designated.

1.03 Remove previous Issue 1 or 1S, and Addendum Issue 2 from your files and replace it with this Issue 2.

1.04 Associated publications are listed in Tables 1 and 2. Channel bank installation, testing, and troubleshooting procedures are in Section 342-911-134. Refer to Section 342-911-550, 9004B ESF PCM Channel Bank User's Guide, for commands and menus associated with the new ESF common equipment option.

1.05 Table 3 lists the mnemonics used in the practice and their definitions.

1.06 The equipment covered in this Section is the latest model as of the publication date. Later models are capable of greater application or are more effective in performance of their function than earlier models. A later model supersedes an earlier model of the same type number and may always be substituted for the earlier model.

1.07 Refer to Section 342-911-050 for information on Federal Communications Commission (FCC) compliance (i.e., Part 15 Subpart J and Part 68) for the 9004B and Translink systems. This information is utilized when these systems are used in customer premises applications.

Table 1. Associated Publications.

Equipment	Practices
25000 Series PCM Repeatered Line Equipment, Inside Plant	342-250-100
9004B PCM Channel Bank, Installation and Maintenance	342-911-134
9004B ESF User's Guide	342-911-550
9004A PCM Channel Bank, Functional Operation, Engineering, and Ordering	342-911-111
9004A PCM Channel Bank, Installation and Maintenance	342-911-112
9140A Digital Test Set	342-911-125
9002B PCM Channel Bank (includes 91232 test set) *	342-911-107
FCC Requirements for the 9004A, 9004B, Translink I, and Translink II Systems	342-911-050
Digital Signal Cross-Connects (DSX)	836-910-080
9122A Asynchronous Digital Multiplexer*	342-911-122
9104A PCM Repeatered Line Equipment, Inside Plant	342-910-105
5215B Miniature Jackfield Assembly	342-521-100
Handling Considerations for Electrostatic Discharge Sensitive Equipment	300-000-001
Telephone Central Office Grounding of Transmission Equipment	795-805-073

* Product currently on A&M status.

Table 2. Channel Unit Publications.

Channel Unit	Section
91401 Four-Wire	342-911-116
91402 Two-Wire E&M (900 ohms	-114
91404 Four-Wire E&M	-114
91403 DPO and 91405 DPT	-117
91407 Four-Wire Tandem	-119
91408 FXO and 91409 FXS	-115
91411 4W Loop Simplex Originating	-118
91412 5/8 kHz Program Transmit	-126
91413 5/8 kHz Program Receive	-126
91414 8/15 kHz Program Transmit	-127
91415 8/15 kHz Program Receive	-127
91434 Four-Wire Single Frequency (Note 1)	-120
91434-12 Four-Wire Single Frequency	-157
91450 Stop Dial/Wink Originating	-128
91451 Four-Wire TO/ETO	-136
91452-11 Two-Wire E&M (900 ohms)	-129
91454-11 Four-Wire E&M	-130
91458 Two-Wire FXO and 91459 FXS	-131
91458-12 2-W FXO/GT and 91459-12 FXS/GT	-158
91466-01 AR-OCUDP (Note 3)	-160
91467-01 AR-DS0DP (Notes 2&3)	-160
91468-01 AR-DSUDP (Note 3)	-161
91470 DPO/ICT and 91471 DPT/OGT	-121
91478 Four-Wire FXO and 91479 FXS	-138

NOTES:

1. An external 26000 Hz signal must be added to the channel unit slot.
2. For use at Central Office end only.
3. All rate data ports. User selectable 2.4,4.8, 9.6, 19.2, or 56 Kb/s.

Table 3. List of Mnemonics and Definitions (Sheet 1 of 2).

MNEMONIC	DEFINITION
ACO	Alarm Cut Off
ACU	Alarm and Control Unit
AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
AMPSC	Advanced Multiprotocol Serial Controller
AR-OCUDP	All Rate - Office Channel Unit Data Port
AR-DS0DP	All Rate - Digital Signal Zero Data Port
AR-DSUDP	All Rate - Digital Service Unit Data Port
BCH	Bose-Chaudhuri-Hocquenghem
BPV	Bipolar Violations
B8ZS	Bipolar 8 Zero Substitution
CMS	CRT Maintenance Shelf
CO	Central Office
CODEC	Coder-decoder
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CSU	CRT Switching Unit or Channel Service Unit
CV	Coding Violations
DCP	Data Collection Processor
DDS	Digital Data System
DIP	Dual In-Line Package
DM	Degraded Minute
DP	Degraded Performance
DPO	Dial Pulse Originating
DPT	Dial Pulse Terminating
DTE	Data Terminal Equipment
DSU	Digital Service Unit
EFS	Error-Free Seconds
EPROM	Erasable Programmable Read Only Memory
ERL	Echo Return Loss
ES	Errored Seconds
ESF	Extended Superframe Format
FCC	Federal Communications Commission
FDM	Frequency Division Modulation
FDL	Facility Data Link
FE	Framing Error
FIFO	First In, First Out
FXO	Foreign Exchange Office
FXS	Foreign Exchange Subscriber
HDLC	High-Speed Data Link Controller
HSCC	High-Speed Serial Communications Controller
I/O	Input/Output
ISMX	Integrated Subrate Data Multiplexer

Table 3. List of Mnemonics and Definitions (Sheet 2 of 2).

MNEMONIC	DEFINITION
LAPD	Link Access Procedure for D-Channel
LBO	Line Buildout
LED	Light Emitting Diode
LIFO	Last In, First Out
LIU	Line Interface Unit
LL	Looped Line
LOC	Local
LOLB	Local Loopback
LOS	Loss of Signal
LPLB	Local Path Loopback
LT	Looped Terminal
MDF	Main Distribution Frame
NBO	Network Buildout
NMI	Non-Maskable Interrupt
NRZ	Non-Return to Zero
OIU	Office Interface Unit
OOF	Out of Frame
OSS	Operation Support System
PCM	Pulse Code Modulation
PDU	Power Distribution Unit
PLLB	Payload Loopback
PM	Performance Monitoring
PRM	Performance Report Message
PSU	Power Supply Unit
RAM	Random Access Memory
RCV	Receive
REM	Remote
RMLB	Remote Loopback
ROM	Read Only Memory
RPIU	Remote Performance Interface Unit
RZ	Return to Zero
SA	System Alarm
SES	Severely Errored Seconds
SF	Superframe Format or Single Frequency
SFE	Severe Framing Errors
SPTS	Signaling Path Test Set
SRL	Singing Return Loss
SYNDES	Synchronizer/Desynchronizer
SYS	System
TB	Terminal Block
TBOS	Telemetry Byte Oriented Serial
TLP	Transmission Level Point
TMB	Trunk Make Busy
TREU	Transmit and Receive ESF Unit
UAS	Unavailable Seconds
VF	Voice Frequency
XMT	Transmit

2. DESCRIPTION

2.01 The 9004B PCM Channel Bank (Figures 1 and 2) consists of a 91430 Terminal Equipment Shelf, common equipment units, and up to 48 channel units. Shelf receptacle connectors are keyed or offset to prevent units from being inserted in the wrong positions.

2.02 The 91418 Transmit/Receive ESF (Extended Superframe Format) Unit (TREU) is a new common equipment plug-in unit that combines the transmit and receive functions of the 91438 and 91439 units, respectively, into a single DS1 interface that can be configured for ESF and clear channel applications. The 91419 Remote Performance Interface Unit (RPIU) is an optional replacement for the 91448 Office Interface Unit (OIU) which provides access to the ESF data link for enhanced monitoring and maintenance of T1 facilities.

2.03 The 91418 and 91419 units are exclusive to the 9004B PCM Channel Bank when operating in Mode 3, utilizing D3/D4 channel sequencing. One 91418 is required for each digroup equipped, while a single 91419 unit supports a full 9004B Channel Bank.

2.04 The 91430 shelf occupies 12 mounting spaces on a standard 19-inch rack. The channel bank is fully self-contained with its own primary DC power fuse, internal talking battery filter, connectorized alarm interface, and 50-pin receptacle connectors for cabling the VF and signaling/supervisory leads of 48 channels to the office equipment.

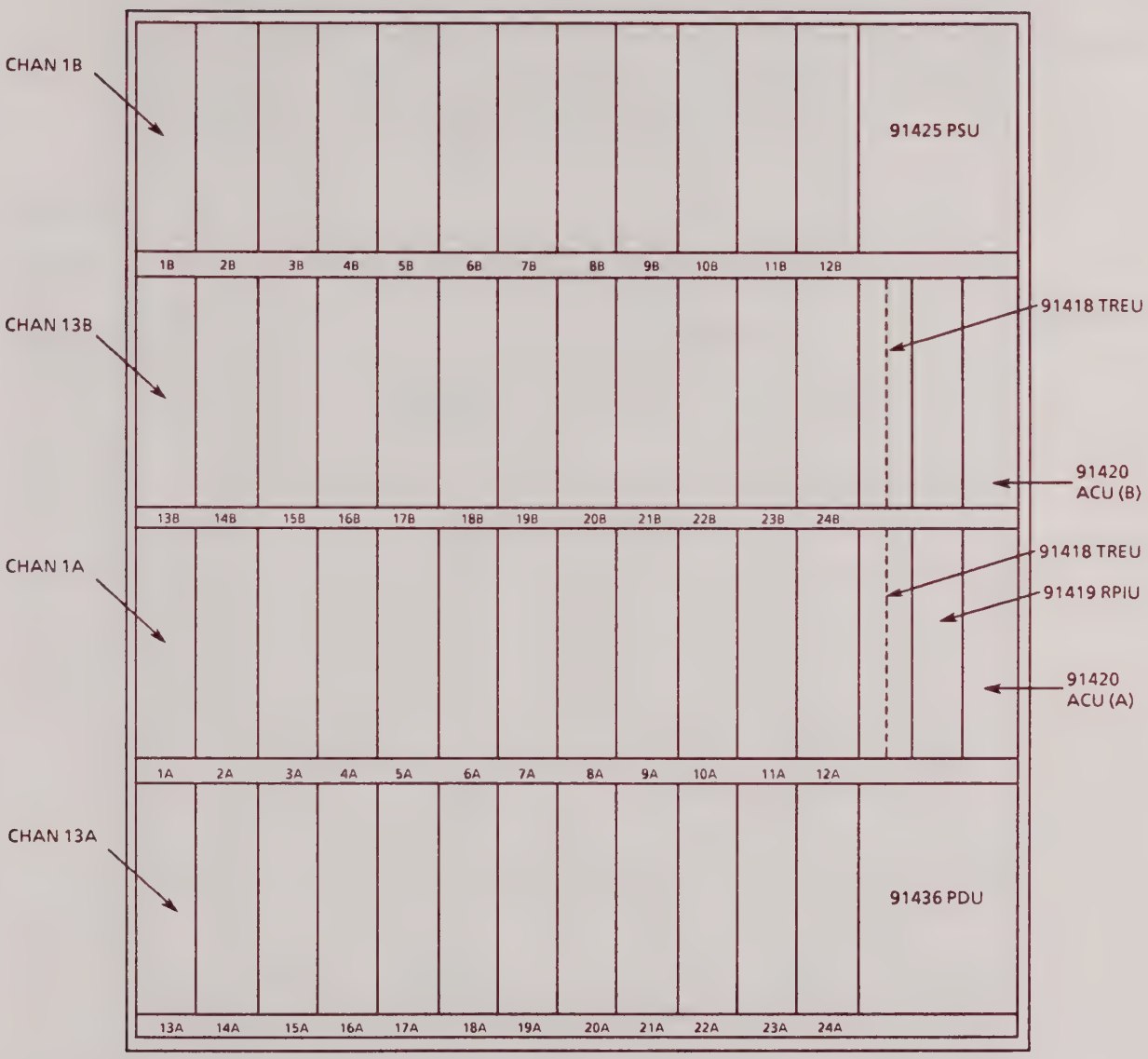
2.05 The 9004B meets the applicable AT&T compatibility specifications for electrical performance, including alarm and restoral sequences. The companding characteristic approximates the μ-255 law, the frame and signaling format is 7- 5/6 bits, and the channel sampling sequence (Table 4) is D1D, D2, or D3/D4.

2.06 The 9004B differs from the 9004A by supporting independent digroups (Mode 3) and independent digroup clocks (Modes 2 and 3), while the 9004A shares transmit and receive units with both digroups and provides a single transmit clock for all modes. The 9004B also supports D1D, D2, and D3/D4 channel sequencing; 9004A channel sampling sequence is D3 only.

NOTE: The following units are common to both 9004A and 9004B channel banks:

91420 Alarm Control Unit
91425 Power Supply Unit
91426 Syndes Unit (model 2)
91448 Office Interface Unit
Channel units, all types

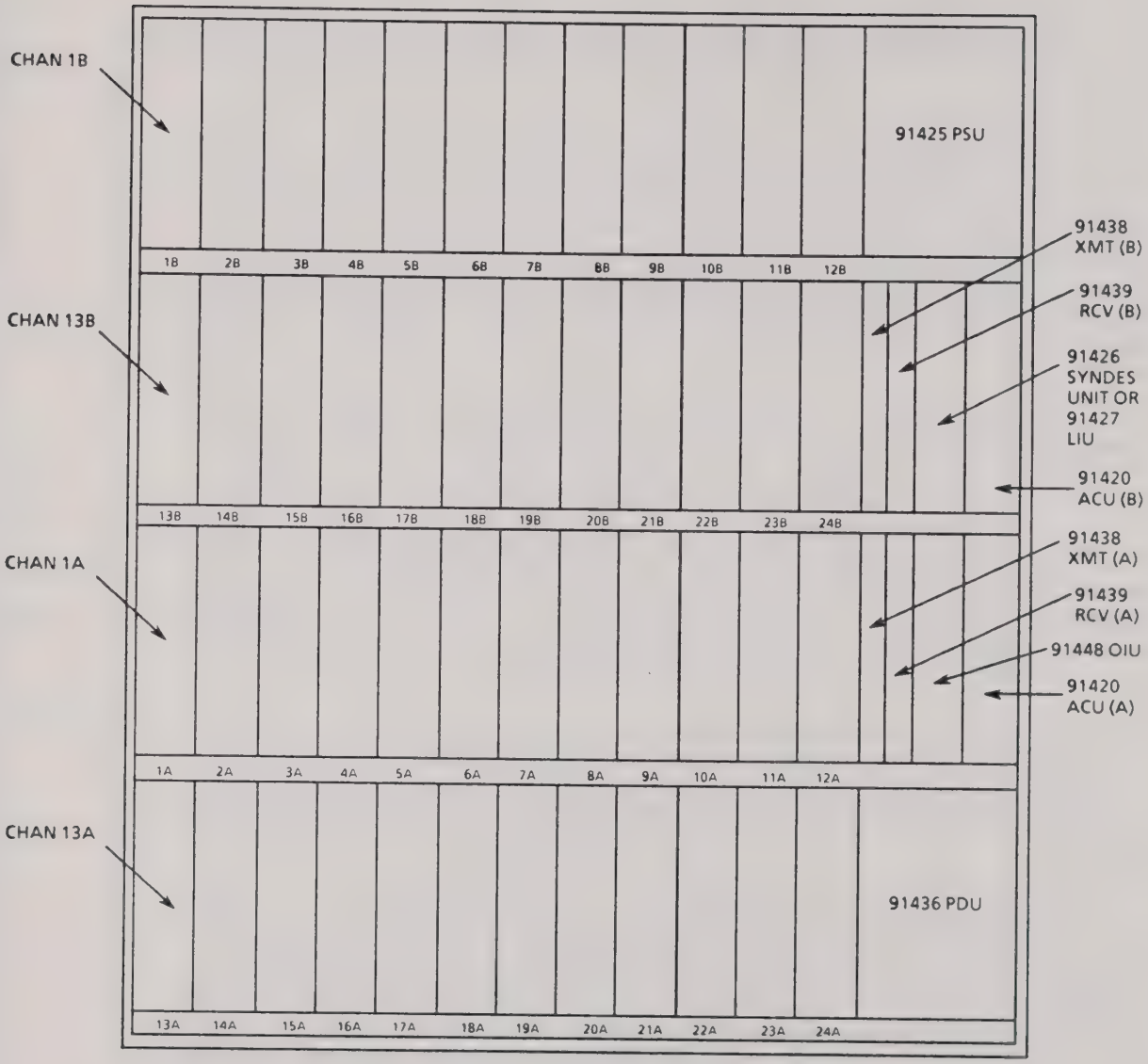
NOTE: The 91418 and 91419 units can only be used with the 9004B.



(A) = Digroup A
(B) = Digroup B
ACU = Alarm Control Unit
PDU = Power Distribution Unit

PSU = Power Supply Unit
RPIU = Remote Performance Interface Unit (one per 9004B)
TREU = Transmit and Receive ESF Unit (one per digroup) and occupies two slots

Figure 1. Terminal Equipment Shelf With ESF Common Equipment.



(A) = Digroup A
(B) = Digroup B
ACU = Alarm Control Unit
LIU = Line Interface Unit

OIU = Office Interface Unit
PSU = Power Supply Unit
PDU = Power Distribution Unit
XMT = Transmit Unit
RCV = Receive Unit

Figure 2. Terminal Equipment Shelf Without ESF Common Equipment.

Operational Modes

2.07 The channel bank periodically samples the VF and signaling/supervisory inputs of 48 channels, converts the analog voltage values into binary digits, and combines these bits into a time-division multiplex signal. At the far end of the system, the channel bank converts the digital signal back to analog signals on the 48 channels.

Table 4. Channel Sampling Sequence.

DS1 TIME SLOT	Channel Number		
	D3/D4 * Sequence	D2 Sequence	D1D Sequence
1	1	12	1
2	2	13	13
3	3	1	2
4	4	17	14
5	5	5	3
6	6	21	15
7	7	9	4
8	8	15	16
9	9	3	5
10	10	19	17
11	11	7	6
12	12	23	18
13	13	11	7
14	14	14	19
15	15	2	8
16	16	18	20
17	17	6	9
18	18	22	21
19	19	10	10
20	20	16	22
21	21	4	11
22	22	20	23
23	23	8	12
24	24	24	24

* The ESF common equipment option supports D3/D4 channel sequencing only.

2.08 The 9004B organizes VF circuits into two 24-channel digital groups, or digroups: channels 1A through 24A in digroup A, and channels 1B through 24B in digroup B. Three operational modes are selected by the appropriate plug-in common equipment units. These modes are summarized below. Refer to Figure 3 for application diagrams.

(a) Mode 1. The digital line interface is a single 48-channel DS1C signal (3.152 Mb/s) suitable for transmission over conventional T1C span lines, or equivalent. The distant terminal must be a 9004A, 9004B, or AT&T D4-type channel bank operating in Mode 1. The two digroup signals are interleaved into 394-bit frames, but the frame format is not compatible with an M1C multiplexer.

(b) Mode 2. Operationally equivalent to Mode 1 but this mode differs only in its M1C frame structure. The distant terminal may be 9004A, 9004B, or AT&T D4-type channel banks operating in Mode 2. A 9122A or M1C multiplexer operating with AT&T D3-type channel banks is also compatible. Independent digroup channel sampling sequence selection (D1D, D2, D3/D4) is established via strapping options.

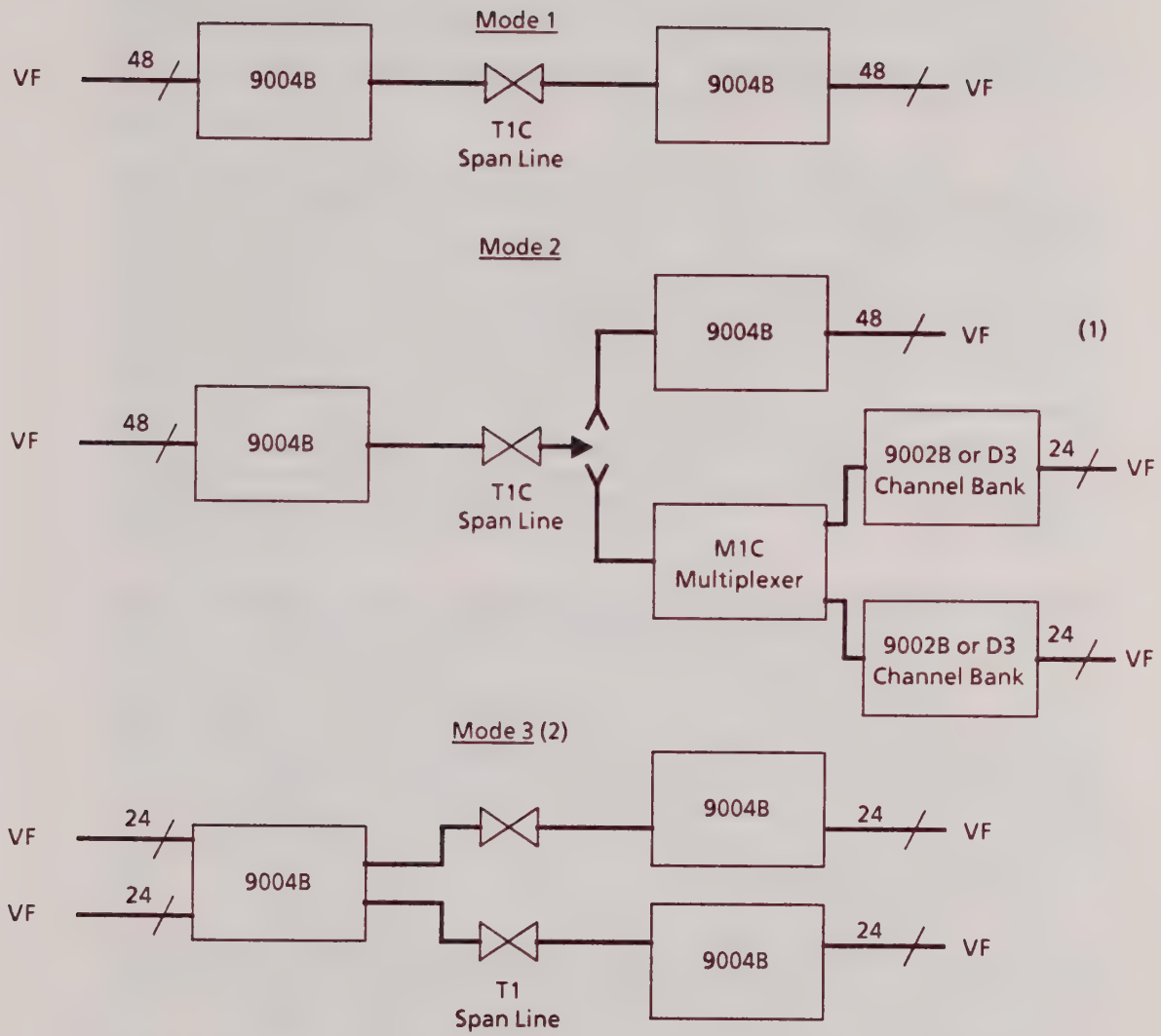
(c) Mode 3. The digital line interface is two 24-channel DS1 signals (1.544 Mb/s) suitable for transmission over two standard 9104A (T1) span lines. The distant terminal must be 9004A, 9004B, or AT&T D4-type channel banks operating in Mode 3. In this mode, the 9004B functions as two essentially independent 24-channel terminals. Channel sampling sequence can be D1D, D2, or D3/D4 independently in each digroup.

NOTE: The ESF option is available for Mode 3, D3/D4 channel sequencing only.

Digital Signal Format

2.09 **Superframe Format (SF).** The superframe structure is based upon sampling and digital encoding of VF signal voltage in each channel to derive an eight-bit word. These words are arranged in 24 eight-bit channels with an additional framing bit to produce a 193-bit frame. Frames are transmitted 8,000 times per second to reach the standard 1.544 Mb/s line speed. A single frame is transmitted in 125 μs.

2.10 The eight-bit channel word enables binary encoding of 256 discrete values ($2^8 = 256$). Sample voltages are compared against a 256-step voltage curve whose compression characteristics, i.e. small steps at low voltage levels and larger steps at higher levels, are designed to maintain uniformly low distortion over a wide range of talk volume. This process is known as quantizing.



NOTES:

1. 9002B/D3 channel banks need not be colocated and may be connected to the multiplexer directly or via 9104A/T1 span lines.

2. The ESF common equipment option supports only Mode 3.

Figure 3. 9004B Channel Bank Applications.

2.11 A group of 12 DS1 frames (2,316 bits) combine to form a D4 superframe. The 12 framing bits (F-bits) are utilized for synchronization of terminal equipment (F_+) and multi-frame alignment (F_S). Supervision of voice channels (on/off-hook condition, ringing, etc.) is accomplished by "robbing" the least significant bit of each channel and placing the information in frames 6 and 12 of the superframe (refer to Figure 4). A D4 superframe requires 1.5 msec for transmittal.

2.12 The 9004B PCM channel bank meets the DS1 superframe format specifications found in ANSI T1.107-1988, Digital Hierarchy - Formats Specification.

2.13 **Extended Superframe Format (ESF).** ESF extends the D4 frame from 12 DS1 frames to 24 DS1 frames of 193 bits each (4,632 total bits). The ESF frame now contains 24 framing (F) bits and requires 3 ms for transmittal (Figure 5). The ESF uses only 6 F-bits (2 kbs) for the framing pattern sequence. An additional 12 F-bits (4 kbs) is used to form the Facility Data Link (FDL). The remaining 6 F-bits (2 kbs) provide the Cyclic Redundancy Check (CRC-6). The ESF option can be utilized with Alternate Mark Inversion (AMI) or Bipolar with Eight Zero Substitution (B8ZS) line codes.

NOTE: The ESF framing format and B8ZS line code options are only available with Mode 3, D3/D4 channel sequencing.

2.14 **Digroup Frame, Mode 2 or 3.** See Figure 6a. In each frame, there are 192 PCM bits (24 eight-bit channel words) plus an added S-bit ("shared" bit) to control terminal framing and signaling frame identification. The terminal framing bits, designated Ft, have a 101010 pattern in odd-numbered frames 1 through 11 of a superframe. The signaling framing bits, designated Fs, have a 001110 pattern in even-numbered frames 2 through 12.

2.15 The Mode 3 digroup signal derives a 1.544 Mb/s line speed by sampling each 193-bit frame 8,000 times per second. Time slot size for a single bit is 648 ns. An eight-bit channel word is 5.18 µs in length.

2.16 **Digroup Frame, Mode 1.** See Figure 6b. The Mode 1 digroup frame is similar to Mode 2 and 3 frames, with one exception: an F-bit (F1, F1, F0, F0) precedes the PCM word for channels 1, 7, 13, and 19. This 1100 F-bit pattern is not presently monitored in the 91439 Receive Unit but is reserved for future applications.

2.17 Each frame contains 192 PCM bits plus five additional control bits. These 197 bits are sampled 8,000 times per second to derive a Mode 1 signal line speed of 1.576 Mb/s. Time slot size for a single bit is 634ns. The eight-bit channel word is 5.07 µs in length. A single frame is transmitted in 125 µs.

2.18 **Line Signal, Mode 1.** The bits from digroup A and digroup B are interleaved to form the double-digroup sequence shown in Figure 6c. Each bit from digroup A is followed immediately by the corresponding bit from digroup B. Adjacent S-bits have the same phase (1 or 0).

2.19 The sequence of bits formed by the interleaving is processed by a one-bit scrambler in the 91427 Line Interface Unit and becomes the transmission line signal.

2.20 **Line Signal, Mode 2.** The M1C multiframe (Figure 6d) has 1,272 bits arranged in four 318-bit subframes designated M1, M2, M3, and M4. In turn, the subframe has six segments, each consisting of a control bit followed by 52 data bits. The data bits, including S-bits, are selected alternately from digroup A and digroup B (Figure 6a). In addition, one or two stuffed bits per digroup are inserted in a multiframe as needed to build out the line signal rate to 3.152 Mb/s nominal.

2.21 In the transmit direction, the digroups are not synchronized and there is no correlation between adjacent A and B bits. But in the receive direction, depending on the originating equipment, the digroups may or may not be synchronized in frequency.

2.22 The combined digroup A and B data, including S-bits, goes through a one-bit scrambler in the 91426 Syndes Unit, after which control bits are inserted as shown in Figure 6d. The control bits and their functions are described below.

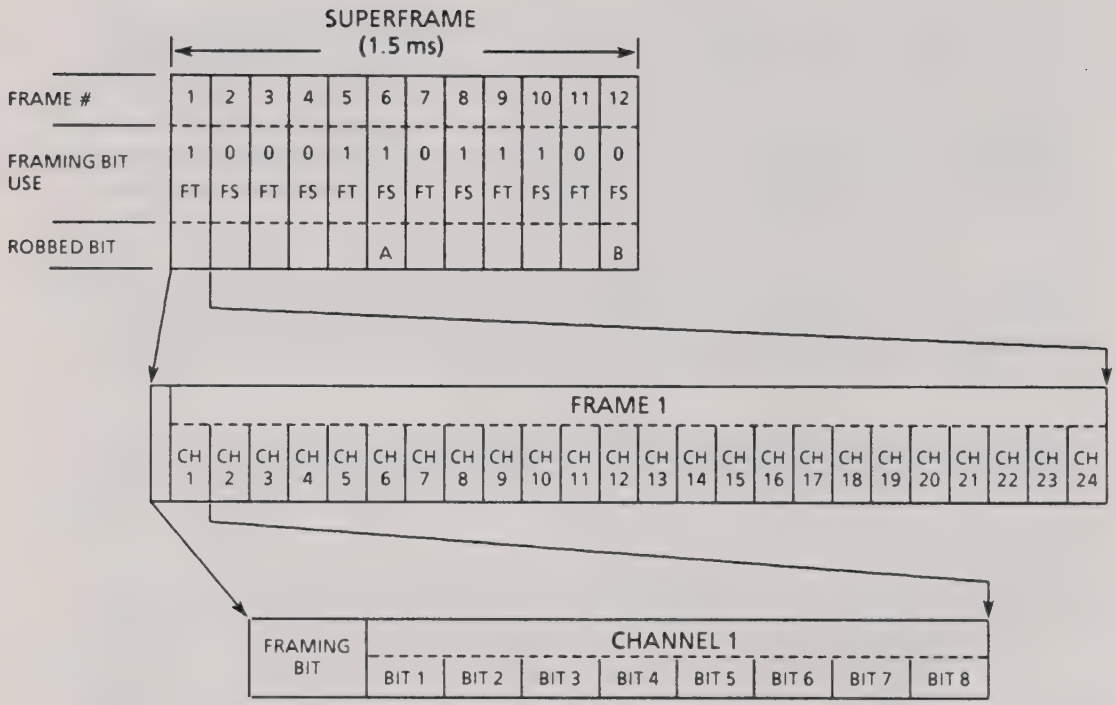
(a) F-Bits. The alternating 1/0 pattern of the F-bits is the basis for frame synchronization in the receive branch of the 91426 Syndes Unit.

(b) M-Bits. The M-bit pattern 011x identifies subframes M1, M2, M3, and M4. The state of the M4 bit (designated "x") is normally transmitted as a 1 but changes to 0 as an out-of-frame indication to the receive terminal.

(c) C-Bits (refer to Figure 6e). Ca, Cb, and Cc are 0 if the subframe does not contain stuffed bits and 1 if it does. The stuffed position is the third time slot for the applicable digroup following Cc.

2.23 **Line Signal, Mode 3.** The SF format of each Mode 3 line signal is the same as the digroup signal in Figure 6a.

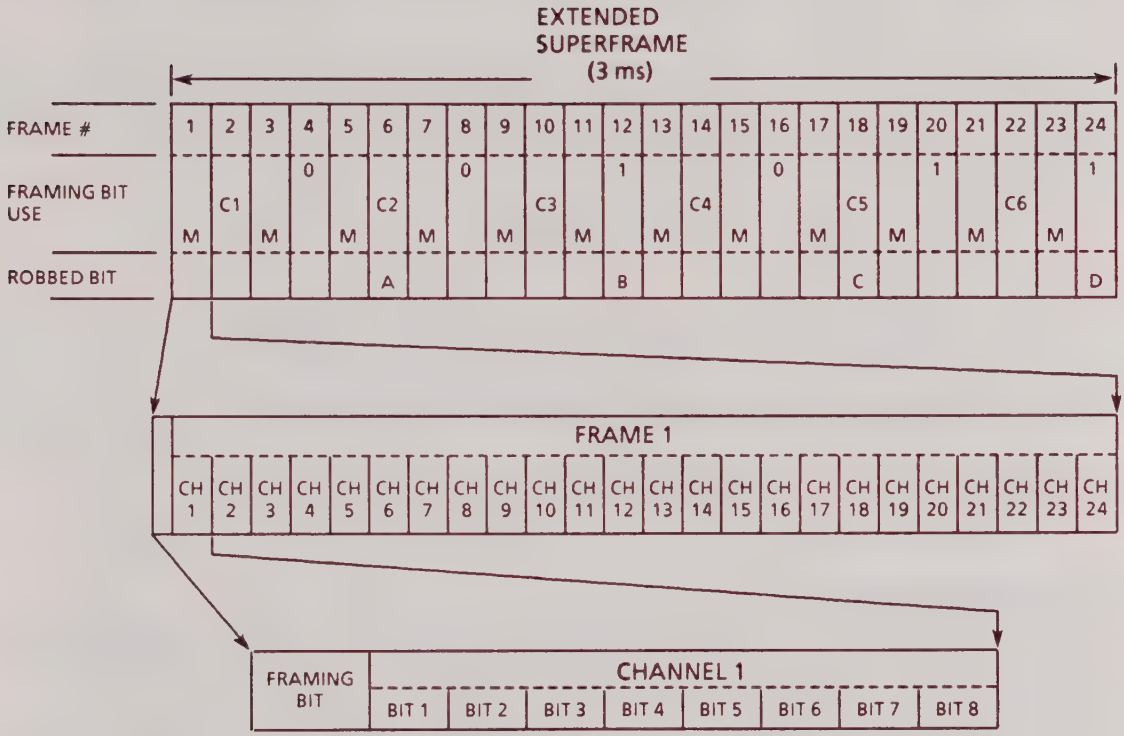
2.24 B8ZS line code and ESF framing format options are only available in Mode 3 applications.



NOTES:

1. Terminal framing pattern is "101010" in framing bit position of odd-numbered frames.
2. Signal framing bits "001110" are in even-numbered framing bit positions.

Figure 4. D4 Superframe Structure.



NOTES:

1. Framing pattern sequence is "001011" in framing bit position of frames numbers 4, 8, 12, 16, 20, 24.
2. Cyclic Redundancy Check (CRC) bits are in framing bit position of frames numbers 2, 6, 10, 14, 18, 22.
3. Message channel (4 kb/s data link) is in framing bit position of odd-numbered frames.

Figure 5. Extended Superframe Structure.

FIGURE 6a. DIGROUP FRAME, MODE 2 OR 3.

Bits per frame = 193
Bit rate = 1.544 MBS/S

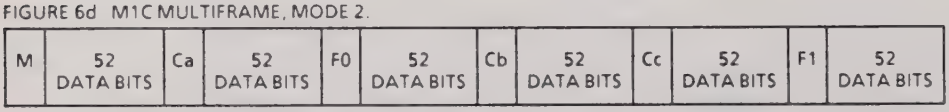
FIGURE 6b. DIGROUP FRAME, MODE 1.

Bits per frame = 197
Bit rate = 1.576 MBS/S

FIGURE 6c. INTERLEAVED DIGROUPS, MODE 1.

Bits per frame = 394
Bit rate = 3.152 MBS/S

FIGURE 6d M1C MULTIFRAME, MODE 2.

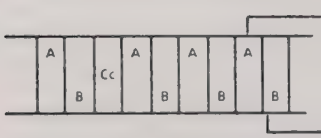


M1, M2, M3, OR M4 SUBFRAME

MULTIFRAME

Bits per multiframe = 1,272
Bit rate = 3.152 Mb/s
M bit in subframes M1, M2, M3, M4 = 0,1,1,1 (If the 91426 Syndes Unit loses frame synchronization, bit M4 is changed from 1 to 0 to provide an alarm indication to the remote terminal.)

FIGURE 6e BIT STUFFING, MODE 2.



Ca, Cb, C_c = 1 If stuffed bit is present. The stuffed bit position is the third time slot for the applicable digroup following c_c. Stuffed bits for digroup A are in subframes M1 and M3; stuffed bits for digroup B are in subframes M2 and M4

Figure 6. Digital Signal Format.

Main Signal Flow

2.25 Figure 7 is a simplified diagram showing main transmission paths (heavy lines) through the channel bank. Digital VF and signaling/supervisory information flows between the 24 channel units and the transmit/receive interfaces via a serial transmit bus (PCMT) or receive bus (PCMR'). The transmission paths are functionally equivalent with either the 91438/91439 Transmit and Receive Units, or the 91418 TREU.

NOTES:

1. In the paragraphs that follow, reference is made to transmit and receive units. Because the new 91418 combines the transmit and receive units into one unit, assume the explanation is also referring to the transmit or receive portion of the 91418 unit.

2. The 91418 TREU operates exclusively in Mode 3, with D3/D4 channel sequencing. References to Mode 1 or Mode 2 apply to the 91438/91439 Transmit and Receive Units.

2.26 The transmit unit inserts a framing bit (S-bit) into the digroup signal at the beginning of each frame. End-to-end frame synchronization is achieved when the distant receive unit locks onto the S-bit pattern.

2.27 Mode 1 digroup signals are synchronous in terms of frequency, framing, and channel words upon leaving the A and B transmit units. This synchronization also applies to digroup signals entering the respective receive units. Mode 2 and Mode 3 transmit/receive digroup signals may be synchronous or asynchronous in frequency but will always utilize asynchronous framing.

2.28 **Mode 1.** The 91427 Line Interface Unit (LIU) adds F-bits to the synchronized PCM signals leaving the A and B transmit units. The two signals are then interleaved and scrambled (Mode 1 framing format is not M1C compatible). The combined 3.152 Mb/s DS1C bipolar signal goes through a shelf-mounted cable equalizer to the digital line. This signal can be looped back to the receive branch for testing purposes and a substitute all-ones signal is transmitted to the line.

2.29 The receive side of the 91427 Line Interface Unit (LIU) descrambles the 3.152 Mb/s DS1C signal and feeds it, in parallel, to the respective A and B receive units. Each receive unit demultiplexes the signal and feeds the applicable digroup information to the channel units.

2.30 **Mode 2.** The 91426 Syndes Unit synchronizes the A and B digroup frequencies by pulse stuffing. A and B data bits are interleaved, control bits (F, M, and C) are inserted, and the composite signal is scrambled. Mode 2 frame format is M1C compatible. The 3.152 Mb/s DS1C signal goes through a shelf-mounted cable equalizer to the digital line.

2.31 The received DS1C signal is descrambled and demultiplexed into A and B digroups. Only control bits are removed before the signals are sent to the receive units. The 91426 Syndes Unit uses a pattern of F-bits and M-bits to synchronize timing with the incoming signal.

2.32 **Mode 3.** Digroups A and B are independent in Mode 3. The 1.544 Mb/s bipolar DS1 signals are generated by the respective transmit units, where S-bits are added before the signal is sent out to the digital line. Mode 3 receive units accept the individual incoming line signal, and provide clock recovery and frame synchronization.

Timing

2.33 PCM signal timing is typically independent in each transmission direction. Transmit timing is controlled by a 3.152 MHz crystal oscillator in the 91427 LIU (Mode 1) and the 91426 Syndes Unit (Mode 2), and by a 1.544 MHz oscillator in Mode 2 and Mode 3 transmit units. Receive timing is controlled by 3.152 HMz clock recovery circuits in the 91427 LIU and 91426 Syndes Unit and by a 1.544 MHz clock recovery circuit in the Mode 3 receive units.

2.34 Mode 2 and Mode 3 transmit units can be strapped to use the recovered 1.576 MHz or 1.544 MHz receive clock, and the LIU strapped to use the recovered 3.152 MHz receive clock. A Looped Clock (LP CLK) strapping plug on the 91418 or 91438 units, and a Looped Timing (LOOP TIMING) strapping plug on the LIU is used to provide the looped receive option.

2.35 The 91448-02 Office Interface Unit (OIU) can enable an External Clock (EXT CLK) via a strapping option. The 91419-02 Remote Performance Interface Unit (RPIU) provides the same option via a strap selection. This application is described in Part 4 under the heading "Data Channel Units".

2.36 **Common Equipment Timing.** Timing signals between common equipment units, shown as light lines on Figure 7, are described below.

(a) Mode 1.

(1) 1.576-MHz Xmt Clk: derived from a 3.152-MHz oscillator (or other optional timing source) in the line interface unit; has gaps at the F-bit time slots.

(2) 3.152-MHz Rcv Clk: recovered from the DS1C receive signal.

(3) Sync': a pulse occurring every 12th frame; coordinates F-bit time slots in the 91438 Transmit Unit and 91427 Line Interface Unit.

(b) Mode 2.

(1) 1.544-MHz Xmt Clk: "write" clock for the elastic store in the 91426 Syndes Unit; in the looped receive clock option, this clock is 1.576 MHz and has gaps at the control bit time slots.

(2) 1.576-MHz Rcv Clk: derived from the recovered 3.152-MHz receive clock; has gaps at the control bit time slots.

(3) Lp Clk: same as (2); selected by the 91439 (Mode 2).

(c) Mode 3.

(1) Lp Clk in the 91439 and 91418 units is the recovered 1.544-MHz receive clock.

2.37 **Channel Unit Timing.** Although not shown in Figure 7, each transmit unit supplies the following timing signals to the 24 channel units of the digroup: a transmit clock (ClkT'), 24 channel time slot signals (ChPT-1' through -24') and a pulse that identifies signaling frames 6 and 12 (SigEnBT) for non-ESF, and frames 6, 12, 18, and 24 (SigEnBT and SigC/DT) for ESF. Corresponding timing signals to the channel units from each receive unit are designated ClkR', ChPR-1' through -24', and SigEnBR' for non-ESF and SigEnBR' and SigC/DR' for ESF.

2.38 Transmit and receive clocks are either 1.544 MHz with gaps at the S-bit time slots or 1.576 MHz with additional gaps at the F-bit time slots (Mode 1) or the control bit time slots (Mode 2). Clock frequencies in each mode are as follows:

(a) Mode 1: 1.576 MHz

(b) Mode 2: ClkT' is 1.544 MHz, but 1.576 MHz if the looped receive clock option is used. ClkR' is always 1.576 MHz.

(c) Mode 3 (Non-ESF and ESF): 1.544 MHz

FIGURE 7a.

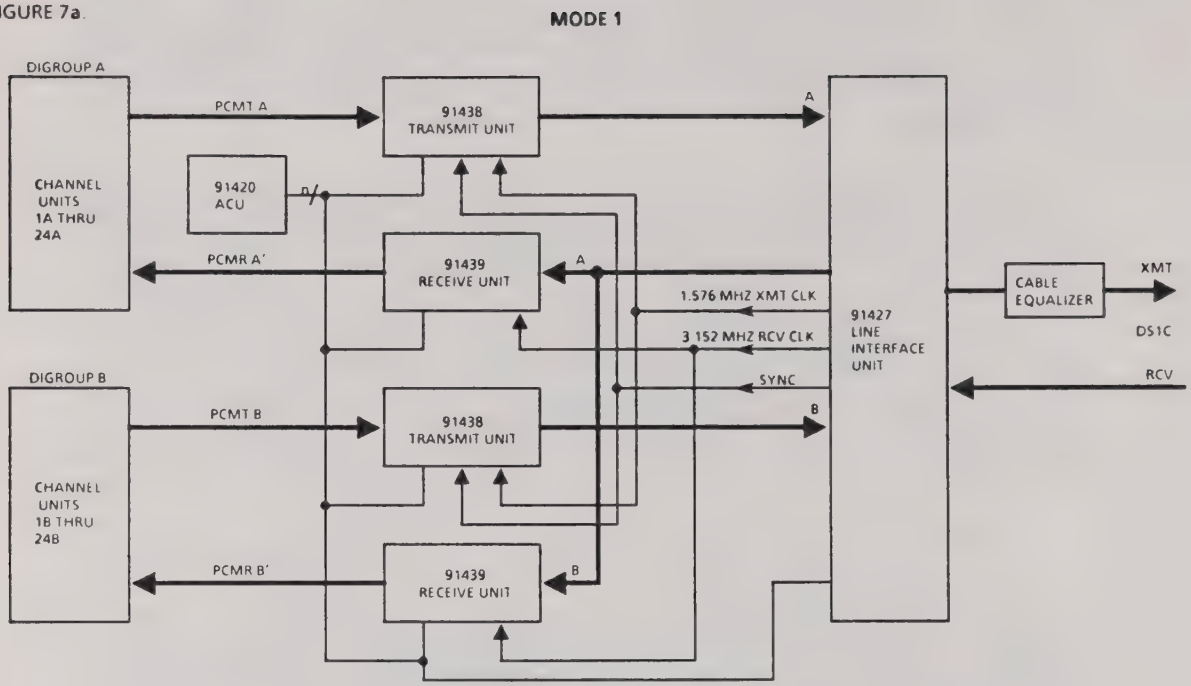


FIGURE 7b

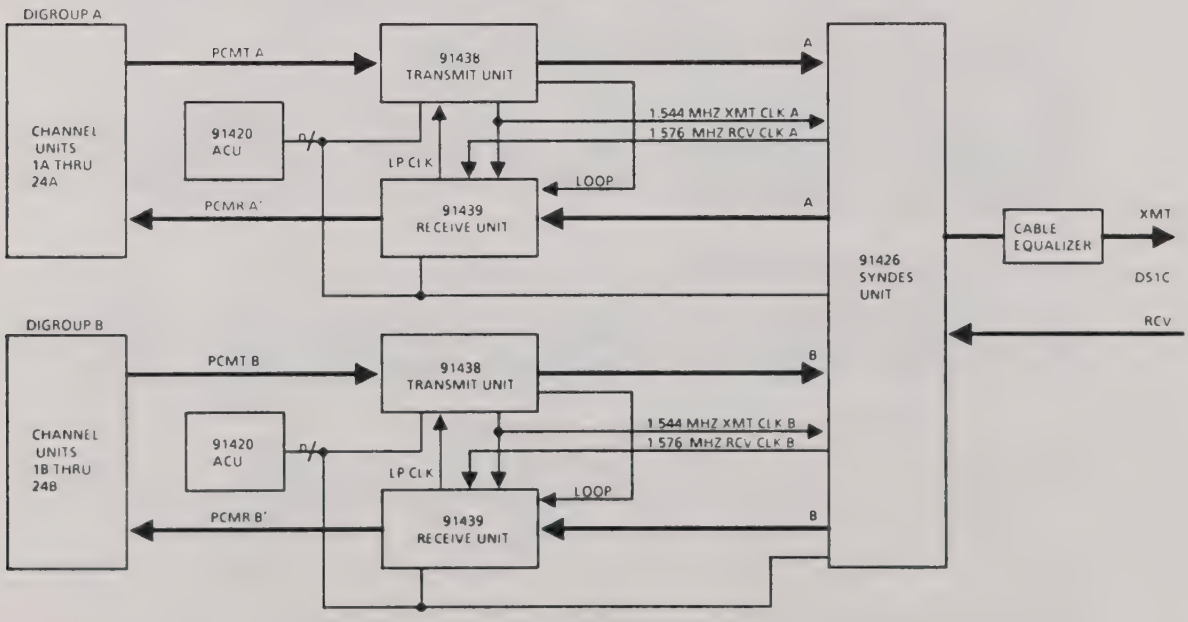


Figure 7. Main Transmission Paths Through the Channel Bank (Sheet 1 of 2).

FIGURE 7c.

MODE 3 (Non-ESF Option)

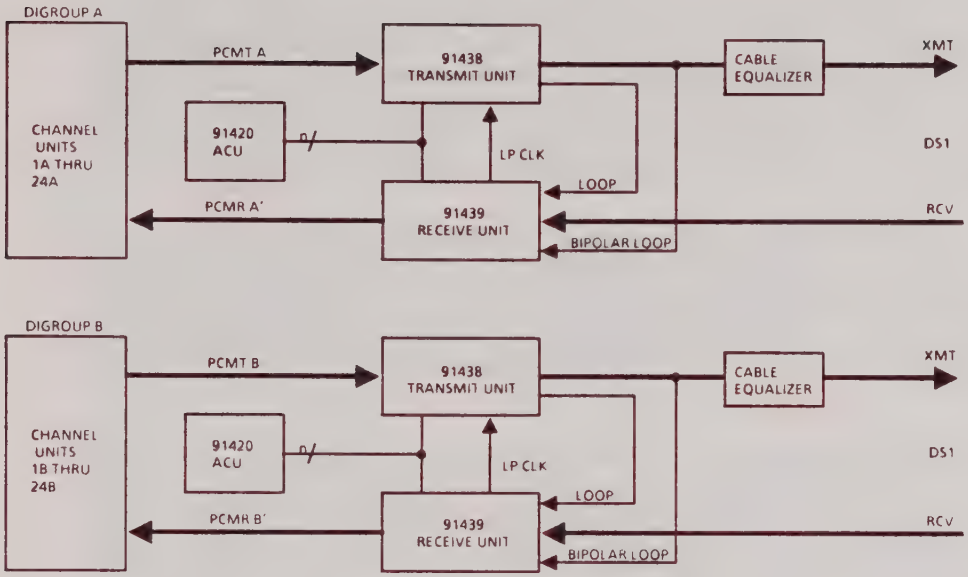


FIGURE 7d.

MODE 3 (ESF Option)

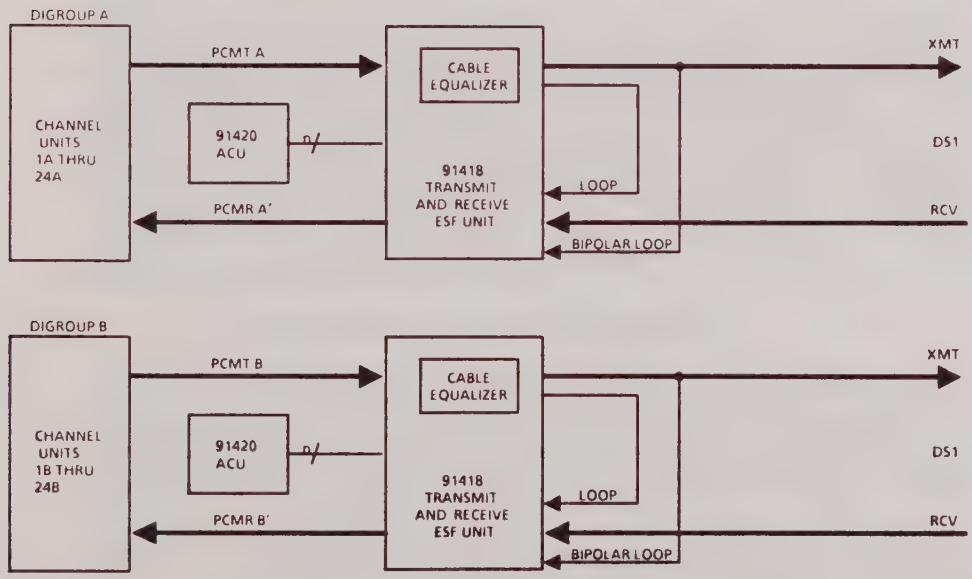


Figure 7. Main Transmission Paths Through the Channel Bank (Sheet 2 of 2).

Looped Terminal Status (Non-ESF Common Equipment Option)

2.39 Looped Terminal (LT) status is enabled by the LOOP pushbutton on the 91420 Alarm and Control Unit (ACU) when the channel bank is in system alarm and the Alarm Cutoff (ACO) activated. The digital transmit signal is looped to the receive branch and an all-1s signal is sent to the line. Mode 1 loop back is at a double digroup point within the 91427. Mode 2 and Mode 3 digroups can be looped independently from the 91438 to the 91439 unit as shown in Figure 7.

2.40 Depressing the TEST pushbutton on the Synchronizer/Desynchronizer (SYNDES) Unit in the LT status unloops the digroup signals and loops the 3.152 Mb/s digital line signal for a 300 ms "fast loop" period. A green PASS LED lights if the syndes unit and both 91439 receive units reframe on the looped signal; otherwise, a red FAIL LED lights.

2.41 **Channel Time Slots.** Timing is altered during LT status so that channel units are linked in pairs through the digital pulse stream. For example, if the channel sampling sequence is D3, channels 1 and 13 "talk" to each other. Signaling is disabled. Channel unit pairs for D3, D2, and D1D sequences are listed in Table 4.

2.42 **Clocks.** If the 91427 (Mode 1) or 91438 units (Modes 2 or 3) are strapped for the "looped receive clock" option, the internal clock is switched in as the transmit timing source during the LT status.

2.43 Because the loopback path in Mode 2 does not include a clock recovery circuit, the 1.544-MHz Xmt Clk from the transmit unit becomes the receive unit timing source in LT status. However, as shown in Figure 7, Mode 3 has two loopback paths. One is unipolar and carries the channel information; the other is the all-1's bipolar transmit line signal, from which a 1.544-MHz clock is recovered in the receive unit.

Table 5. Channel Unit Pairs with Channel Bank in Looped Status.

D3/D4 Sequence	D2 Sequence	D1D Sequence
1 and 13	1 and 2	1 and 7
2 14	3 4	2 8
3 15	5 6	3 9
4 16	7 8	4 10
5 17	9 10	5 11
6 18	11 12	6 12
7 and 19	13 and 14	13 and 19
8 20	15 16	14 20
9 21	17 18	15 21
10 22	19 20	16 22
11 23	21 22	17 23
12 24	23 24	18 24

Looped Line Status (Non-ESF Common Equipment Option)

2.44 Looped line (LL) status is useful for isolating digital line problems. As with LT status, the channel bank must be in system alarm and the alarm cutoff activated. When the TMB HOLD pushbutton on the alarm control unit is depressed, the system alarm and Trunk-Make-Busy (TMB) conditions are maintained and bit 2 of the outgoing eight-bit channel words is forced to 0. If the digital signal is looped back at a repeater location, the yellow REM indicator lights when the line out and back is good, or the red LOC indicator lights when there is a line fault.

ESF Common Equipment Loopbacks

2.45 The ESF common equipment option provides four types of loopback activation: (1) Local Loopback (LOLB); (2) Local (Path) Loopback (LPLB); (3) Remote (Line) Loopback (RMLB); and (4) Payload (Path) Load Loopback (PLLB). Loopbacks are performed on a per digroup basis.

NOTE: The 91420 ACU must be in system alarm for LOLB loopback to be activated via the 91420 or the RPIU. The other loopbacks can be invoked at any time but the RPIU will warn the user that a loss of service will occur if the requested loopback is executed.

(1) **Local (Line) Loopback (LOLB).** LOLB is activated via the 91419 RPIU or by depressing the LOOP pushbutton on the 91420 ACU. Local loopback is shown as item 1 in Figure 8. During LOLB, the digital transmit signal is looped to the receive branch and an all-1s signal is sent to the line. In addition, the receive side channel pulses are shifted such that channel 1 and 13 "talk" to each other. Signaling is disabled. Channel unit pairs for D3/D4 sequences are listed in Table 4. A 1 kHz 0 dBmO tone can be applied to the receive side to test each digroup.

(2) **Local (Path) Loopback (LPLB).** LPLB is only activated via the RPIU. The request is generated from the near end via the local Cathode Ray Tube (CRT) terminal (Figure 8, Item 4). This loopback determines if the framer is functioning properly.

(3) **Remote (Line) Loopback (RMLB).** RMLB is only activated via the RPIU. The request may be generated from the near end via the local CRT terminal (Figure 8, item 2) or sent to the far end via the facility data link (Figure 8, item 5).

(4) **Payload (Path) Loopback (PLLB).** PLLB is only activated via the RPIU. The request may be generated from the near end via the local CRT terminal (Figure 8, item 3) or sent to the far end via the facility data link (Figure 8, item 6). The payload loopback occurs when the 192 information bits in the frame received at the near end are looped back at the far end while the F-bits (framing, CRC-6 or data link) are generated by the near-end terminal, which is being looped back.

Alarms

2.46 **Terminal/System Alarms.** Figure 7 shows the 91420 Alarm Control Unit (one required for Mode 1 and two required for Mode 2 or 3) and how it interfaces with the other units in the channel bank. The single line "n/" represents three inputs (AC1, AC2', and LP Req') and six outputs (AC3 through AC7 and LP'), which are discussed in Part 6.

2.47 Loss of Signal (LOS), Alarm Indication Signal (AIS), a Bit Error Rate (BER) greater than 10-3, or Degraded Performance Alarm (DPALM) detected by the 91419 unit lights the RED LOC indicator on the 91420 ACU. When using the 91438/91439 units, loss of frame synchronization, BER greater than 10^{-3}, or receive signal failure lights the red LOC indicator on the alarm control unit. Should the condition last more than 2.5 seconds, the local bank sends an alarm signal to the remote bank by suppressing bit 2 in the outgoing channel words. The remote bank lights the yellow REM indicator and both banks go into a system alarm condition.

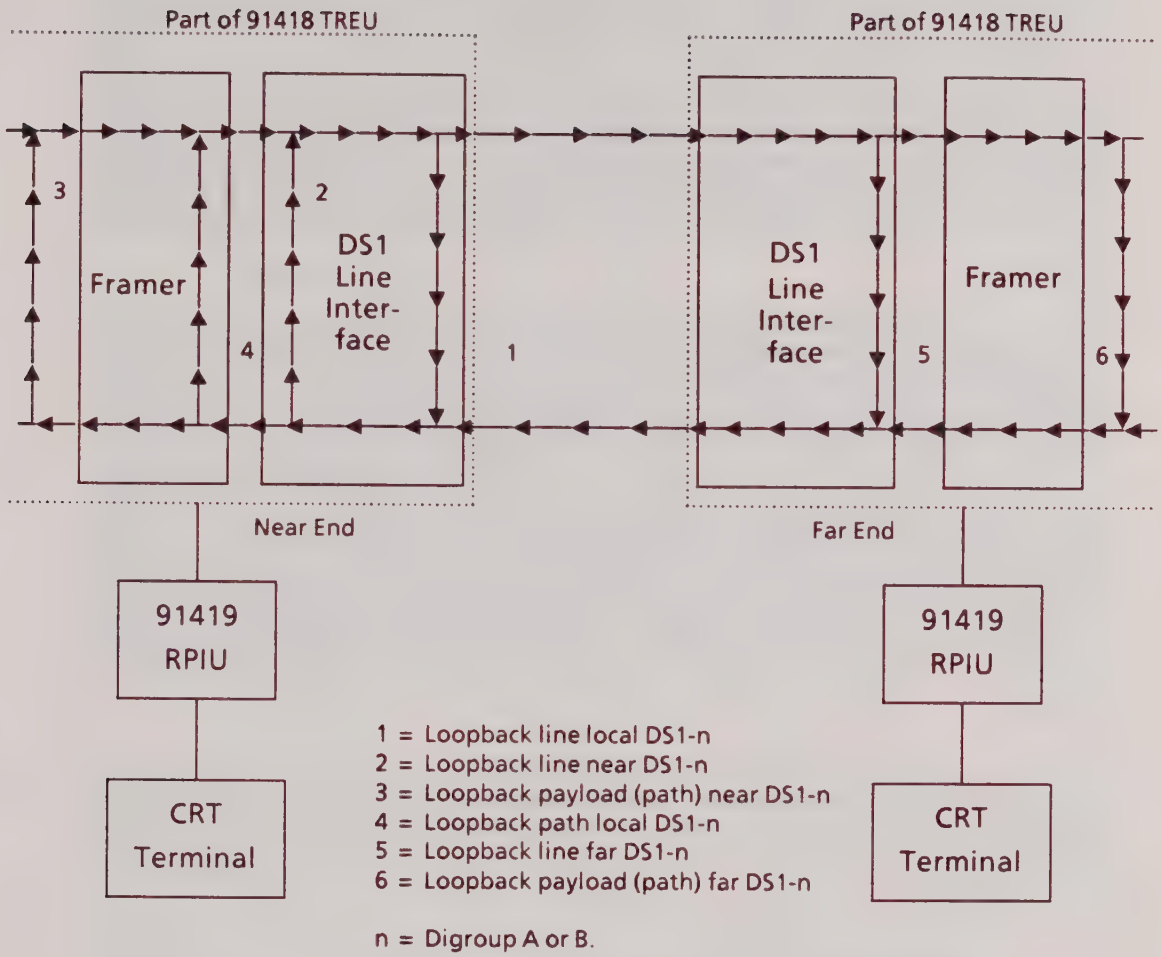


Figure 8. ESF Loopback Options.

2.48 In Mode 1, the alarm signal is transmitted in both digroups, although the remote bank monitors digroup B only. In Modes 2 and 3, the alarm signal is transmitted in the affected digroup(s).

2.49 In Mode 2, an out-of-frame condition at the 48-channel, 3.152-Mb/s signal level, lights an indicator (red LOCAL or yellow REM, as applicable) on the syndes unit but does not control trunk processing. However, the out-of-frame condition will usually appear in the digroup signals also, and a trunk-make-busy (TMB) status on 48 channels will result.

2.50 **Degraded Performance (DP) Alarm (ESF Option).** In Mode 3, the ESF option provides a data link that is used by the 91419 RPIU to monitor each digroup's traffic for degraded performance. The RPIU monitors traffic for Loss of Signal (LOS), Out of Frame (OOF) and Alarm Indication Signal (AIS) conditions, Cyclic Redundancy Check (CRC) block errors, and the number of Bipolar Violations (BPV) received. The system can be programmed via the RPIU to sound a DP alarm when designated performance thresholds have been exceeded. The RPIU can then send a degraded performance alarm to the appropriate TREU which in turn forces the system alarm to be sent to the corresponding digroups ACU. The RPIU can also assign default values for the various performance thresholds. The DP alarm feature can also be programmed not to operate.

2.51 When a performance threshold is exceeded, the DP LED lights for the affected digroup(s) on the RPIU faceplate. If the system has been programed accordingly, an alarm will be sent to the corresponding TREU(s) which will cause a system alarm condition to be reported on the ACU faceplate.

Supervisory System

2.52 Channel bank alarms can be transmitted to a distant location via an external supervisory system using the 91448 OIU. The system also enables remote control of the channel bank digital loopback functions via the 91418 and 91419 ESF units.

Trunk Processing

2.53 When a system failure is detected, an alarm is generated and trunk processing is initiated to remove trunks from service at both ends of the network. When the trouble is cleared, the trunks are returned to service in a coordinated sequence. 9004B trunk processing is compatible with other PCM channel banks but timing (Figure 9) may differ. For Mode 1 operation, trunk processing removes all 48 channels from service. For Mode 2 or 3, only the affected digroup is removed.

2.54 The A signaling/supervisory states of each channel are stored in receive unit registers, which are updated during the signaling frames. If an out-of-frame condition is detected, the states that existed about 10 ms (91439), 24 ms (91418 SF), or 48 ms (91418 ESF) earlier are supplied to the channel units. This information will not have been contaminated by the disturbance that precipitated reframing. If an in-frame condition is achieved within 2.5 seconds, service will be restored, with no change in channel supervisory status. If framing is not restored within 2.5 seconds, a system alarm is generated and regular trunk processing begins.

Channel Units

2.55 Channel units are available to match two-wire, four-wire, or special service VF circuits and various types of signaling and supervision. Part 4 includes a general description of channel units and a typical circuit diagram. For details of particular channel unit types, refer to the applicable Section listed in Table 2.

2.56 An important feature of the 9004B channel bank is that each channel unit has its own Combo/CODEC (coder-decoder). The Combo/CODEC makes the transmit analog-to-digital conversion and the receive digital-to-analog conversion within the channel unit at the common equipment interface.

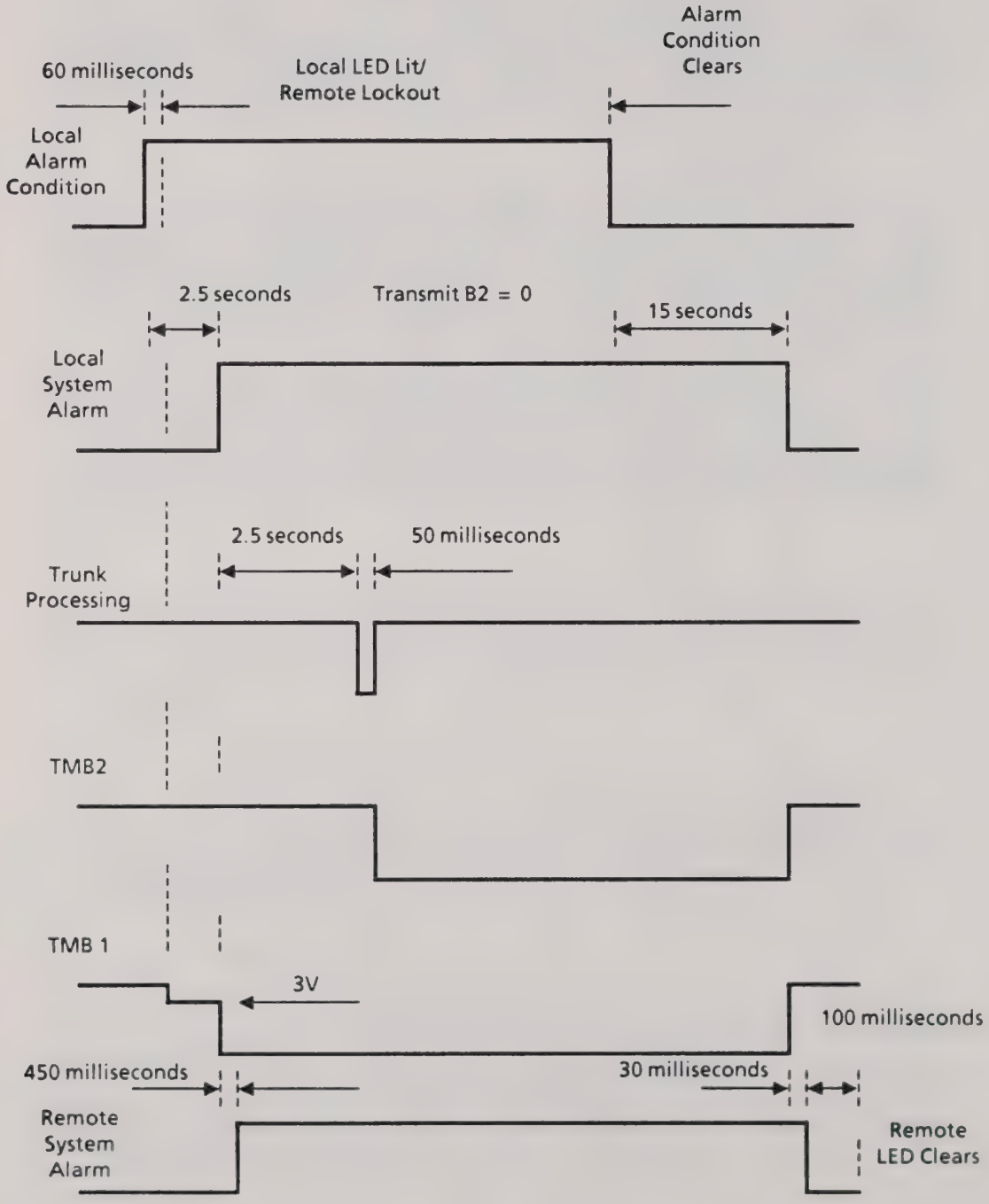


Figure 9. Alarm and Trunk Processing.

3. TERMINAL EQUIPMENT SHELF

3.01 In Part 3, external connections to the channel bank and internal wiring of the terminal equipment shelf are divided into functional circuit categories. Circuits are illustrated in Figures 10 through 20; for example, Figure 10 (ESF common equipment option) and Figure 11 (Non-ESF common equipment option) show PCM and timing signals. The power distribution diagram, Figure 17, also shows circuits within the 91425 Power Supply Unit and the 91436 Power Distribution Unit. Other plug-in units are covered in Parts 4, 5, and 6.

3.02 In the text and diagrams of this publication, a binary signal that is logic 0 in the activated state is identified by a prime symbol (') following the signal name. This symbol has the same meaning as the "bar" used in other publications; for example TMB1' and TMB1, ChPT-1A' and ChPT-1A, or SigEnBR' and SigEnBR refer to the same signals.

NOTE: Unless stated otherwise, the following descriptions pertain to the ESF common equipment option (91418 Transmit and Receive ESF Unit) and the non-ESF common equipment option (91438 Transmit and 91439 Receive Units). In addition, when reference is made to the transmit and receive units, the information also applies, unless noted otherwise, to the 91418 Transmit and Receive ESF Unit (TREU).

PCM and Timing Signals

3.03 Figures 10 and 11 show the main PCM signal paths (heavy lines), the loopback paths from transmit unit to receive unit (91438 to 91439 units or internally looped back within the 91418 unit)), the transmit clock (Xmt Clk), receive clock (Rcv Clk), and looped receive clock (Lp Clk). The configurations of these circuits for Modes 1, 2, and 3 are briefly described in Part 2 and they appear in simplified form in Figure 7. Figure 12 has a separate simplified diagram of the clock circuits in each mode.

NOTE: Figures 19 and 20 show additional timing signals used in certain Digital Data System (DDS) applications of the channel bank. These signals are Ext Clk, Bit Sync', Byte Sync', and Composite Clock.

3.04 At the left of Figures 10 and 11, one channel unit represents the 24 units of the digroup. Connections shown are multipled to all channel units. Each channel unit is connected to a transmit PCM bus (PCMT) and a receive PCM bus (PCMR'). The transmit unit and receive unit of each digroup supply a transmit clock and receive clock to the 24 channel units on the ClkT' and ClkR' buses. Similarly, the transmit unit and receive unit supply signaling timing to the channel units on the SigEnBT and SigEnBR' buses for non-ESF applications. The TREU, configured for ESF, supplies timing to the channel units on the SigEnBT/SigC/DT and SigEnBR' SigC/DR' buses.

3.05 The DS1 and DS1C digital lines terminate at receptacles J66 and J76 shown at the right of Figures 10 and 11. Connections can be made with a mating female plug or by wirewrapping to the pins on J66 and J76.

3.06 According to the cable length between the channel bank and the DSX-1 or DSX-1C cross-connect, one of five equalizers (Figures 11a and 11b) is inserted in receptacles J65 and J75. Equalizers are not required when the 91418 unit is equipped. A strapping plug for cable equalization is supplied with the 91418 unit. Installation instructions are contained in Section 342-911-134.

3.07 Transmit and receive clock buses ClkT' and ClkR' are terminated on each of the four shelf levels by subassembly 087-56940-01 (Figure 11c). The termination prevents clock pulse ringing when the shelf is not fully equipped with channel units. This termination is applicable to both the ESF and non-ESF options.

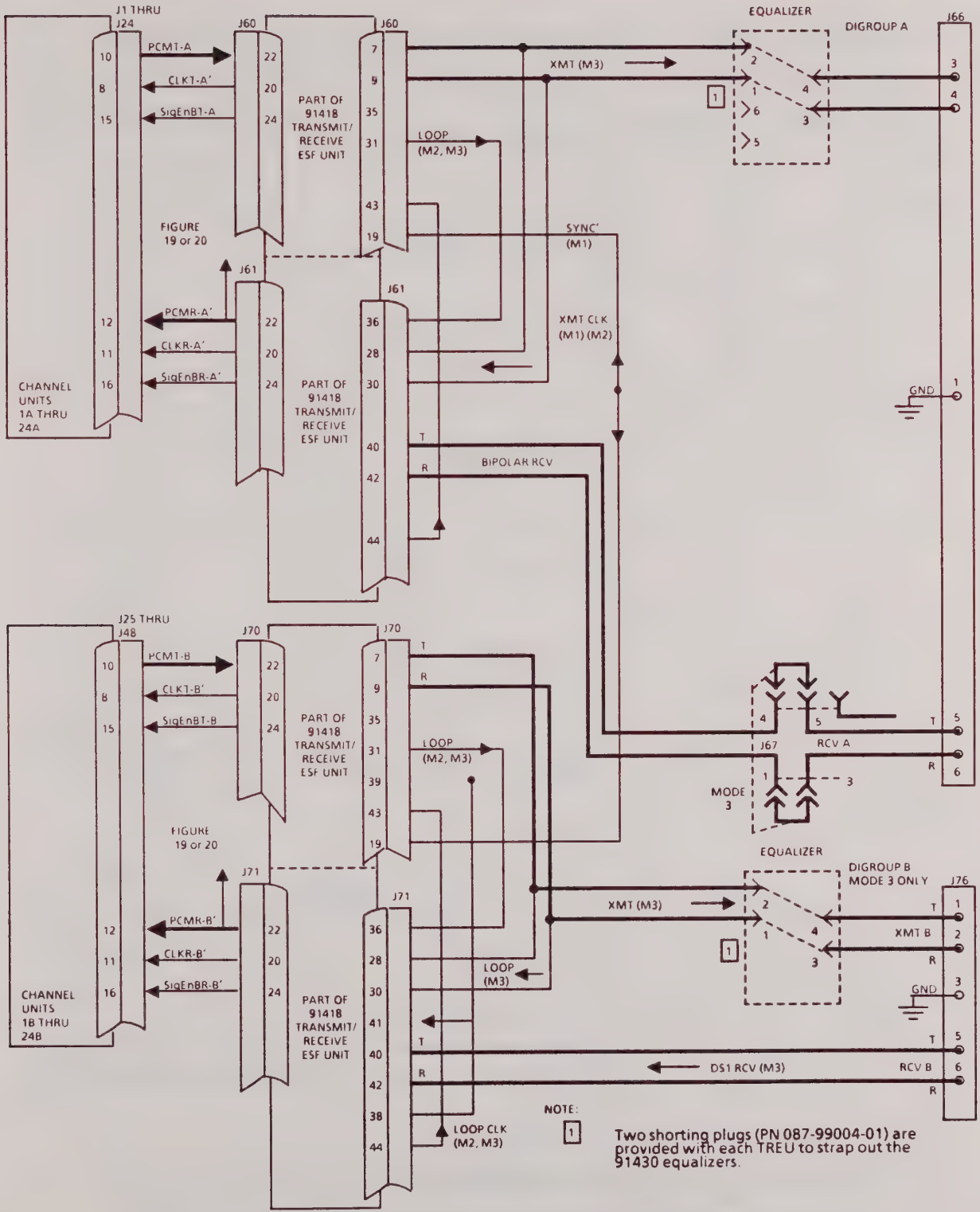


Figure 10. ESF PCM and Timing Signals.

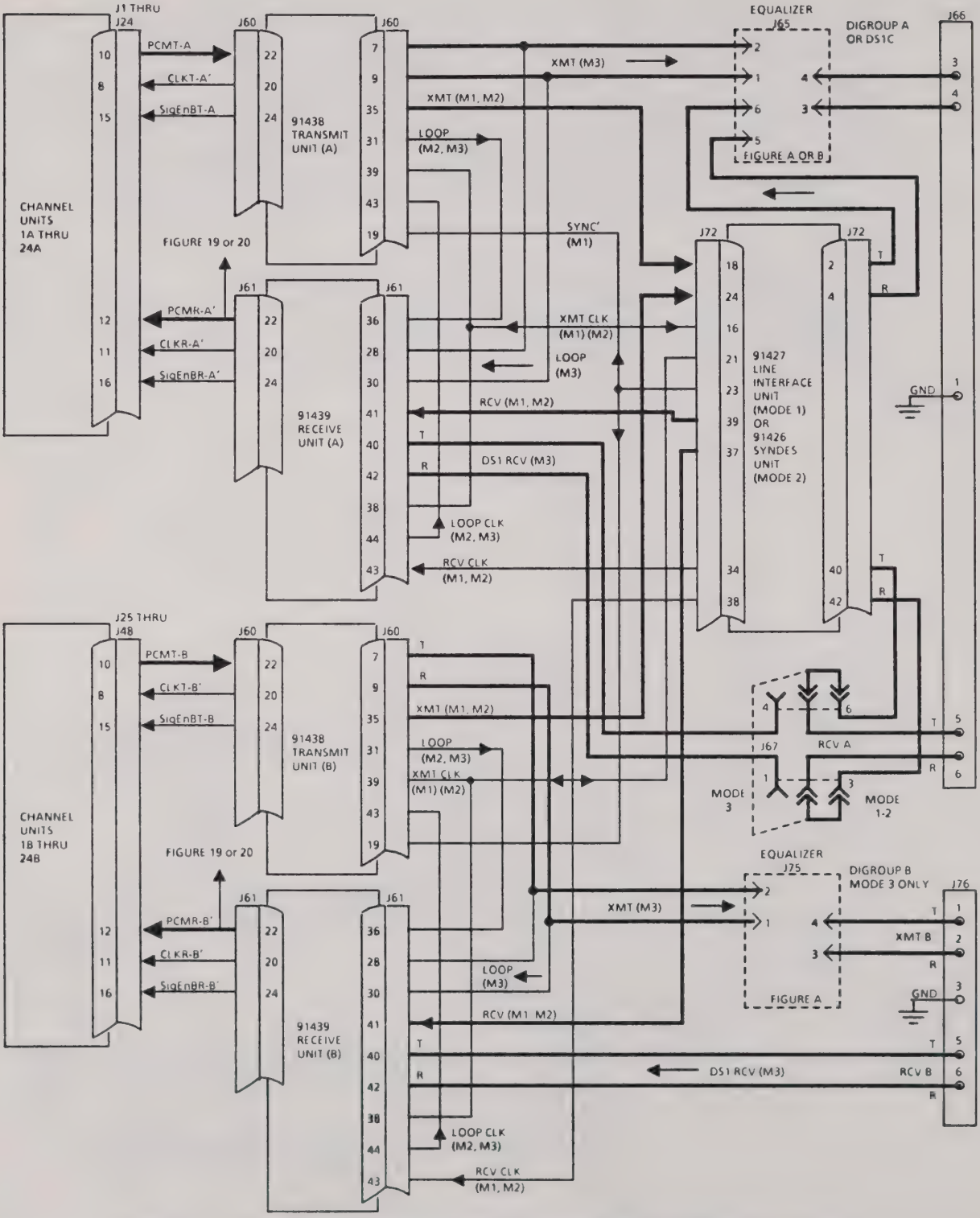


Figure 11. Non-ESF and ESF PCM and Timing Signals (Sheet 1 of 2).

FIGURE 11a. NON-ESF CABLE EQUALIZER IN J65 OR J75, MODE 3

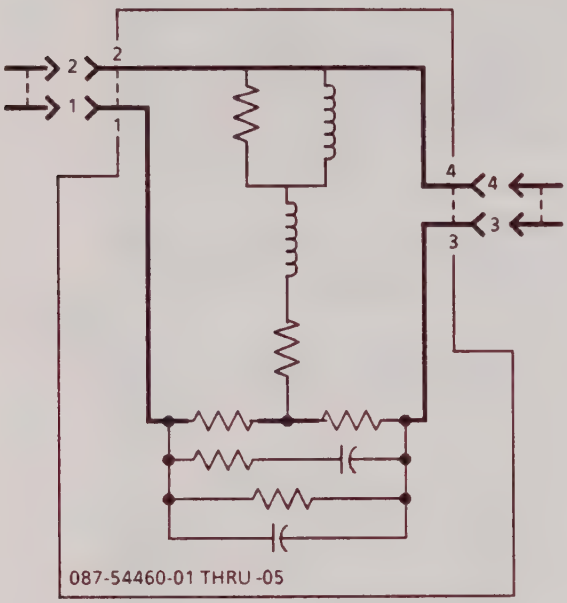


FIGURE 11b. NON-ESF CABLE EQUALIZER IN J65, MODE 1 OR 2

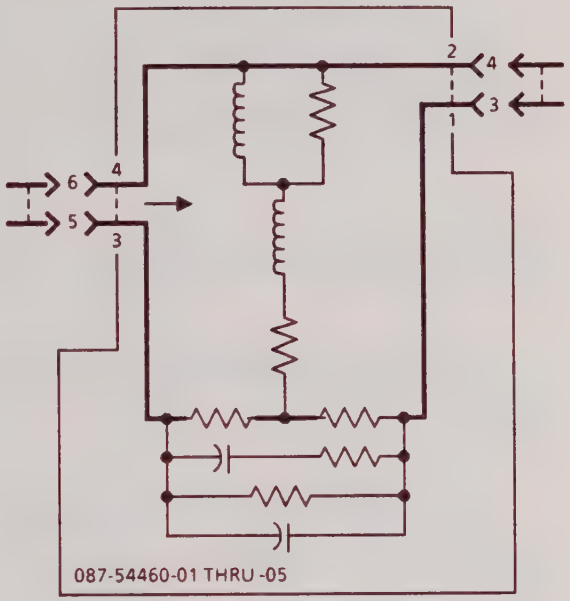


FIGURE 11c. ESF AND NON-ESF CLOCK BUS TERMINATION

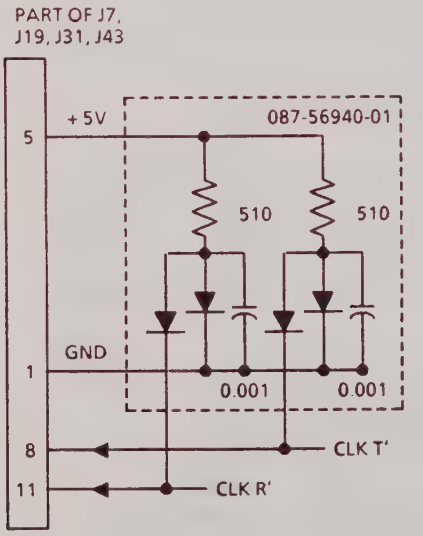
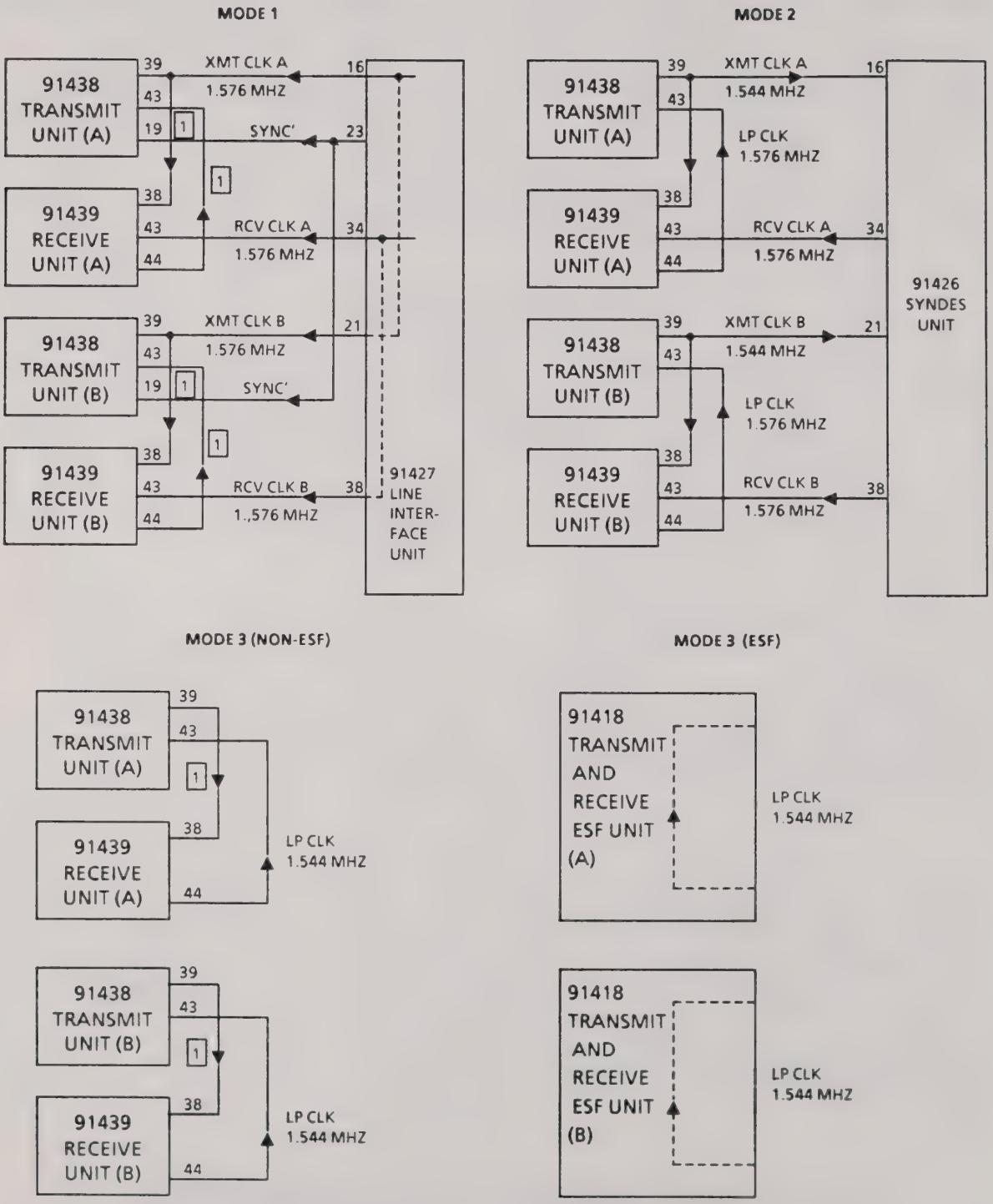


Figure 11. Non-ESF and ESF PCM and Timing Signals (Sheet 2 of 2).



NOTE: [1] A clock signal is present but is not used in the mode specified

Figure 12. Simplified Clock Signal Circuits.

Mode and Channel Sequence Selection

3.08 **Superframe Applications.** Circuits within the transmit and receive units are arranged for Mode 1, 2, or 3 by the M1 Sel' and M2 Sel' lines from receptacle connector J72 (Figure 13). A 91427 LIU plugged into J72 grounds pin 44 and Mode 1 is selected; a 91426 Syndes Unit grounds pin 43 and Mode 2 is selected. Mode 3 results if J72 is unoccupied. Other strapping options affecting alarm operation in Mode 1 vs Mode 2 or 3 are shown in Figure 14.

3.09 In Mode 2 (Figure 13), the transmit units ground the Xmt Intlk A and B lines at pin 37 of J60 and J70. If a transmit unit is removed, the syndes unit transmits an all 1's signal in that digroup.

3.10 Channel sampling sequence is selected independently for each digroup by inserting a strapping plug in the D1D, D2, or D3 position of J64 and J74.

3.11 Pin 51 of J61, designated A Sel', is grounded whereas pin 51 of J71 is tied to +5V. This difference enables the A and B receive units in mode 1 to select the appropriate digroup from the 3.152-Mb/s DS1C signal.

3.12 **Extended Superframe Applications.** In ESF applications only Mode 3 is supported. Internally the 91418 unit selects Mode 3 via the mode/sequence detector.

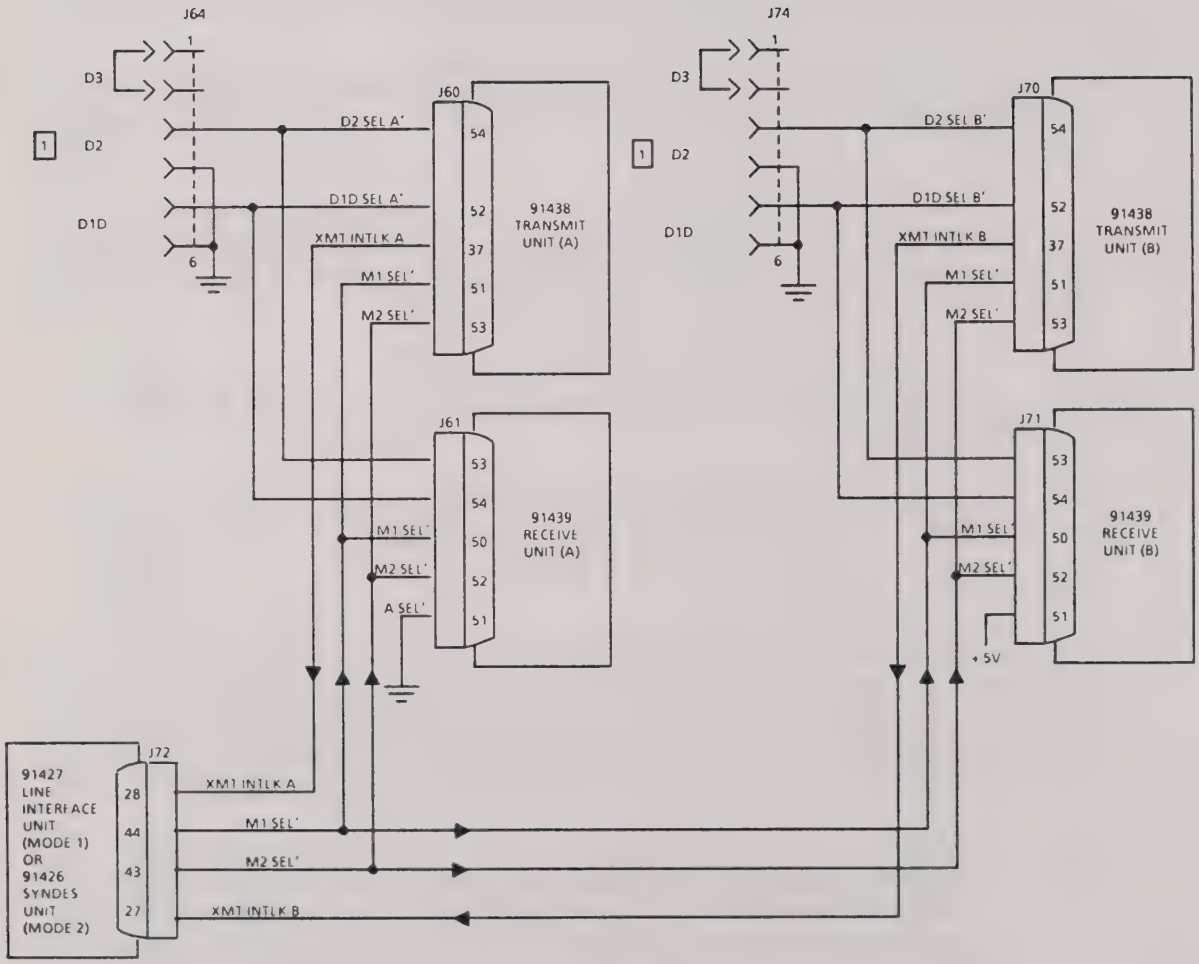
3.13 Channel sequencing of D3 should be selected by inserting a strapping plug in the D3 position of J64 and J74 (Figure 13).

Alarm Circuits

3.14 The 91420 Alarm Control Units (ACUs) on Figure 14a and 14b have the monitored alarm inputs on the left and the alarm control outputs on the right. Inputs are AC1 (local alarm), AC2' (remote alarm), and power alarm. Control outputs are AC3 (VF mute), AC4 (bit 2 suppress), AC5' (loop), AC6' (idle signaling), and AC7 (clock select).

NOTE: Figure 19 shows the additional alarm and control circuits between the ACU's and the 91419 RPIU and between the RPIU and RS-232-C and RS-422 craft interfaces. Figure 20 shows the additional alarm and control circuits between the ACUs and the 91448 OIU and between the OIU and the external supervisory system.

3.15 External connections to the office alarm equipment are made at J63 and J73 as shown in Figure 14c. Figure 14c also shows the three timing signals (TP', TMB1', and TMB2') associated with trunk processing in the channel units during a system alarm.



NOTE: [1] Strapping options. Insert strapping plugs in J64 and J74 for applicable channel sequence.

Figure 13. Mode Select and Channel Sequence Select Circuits - Non-ESF Option.

Figure 14a. ESF Alarm Circuits

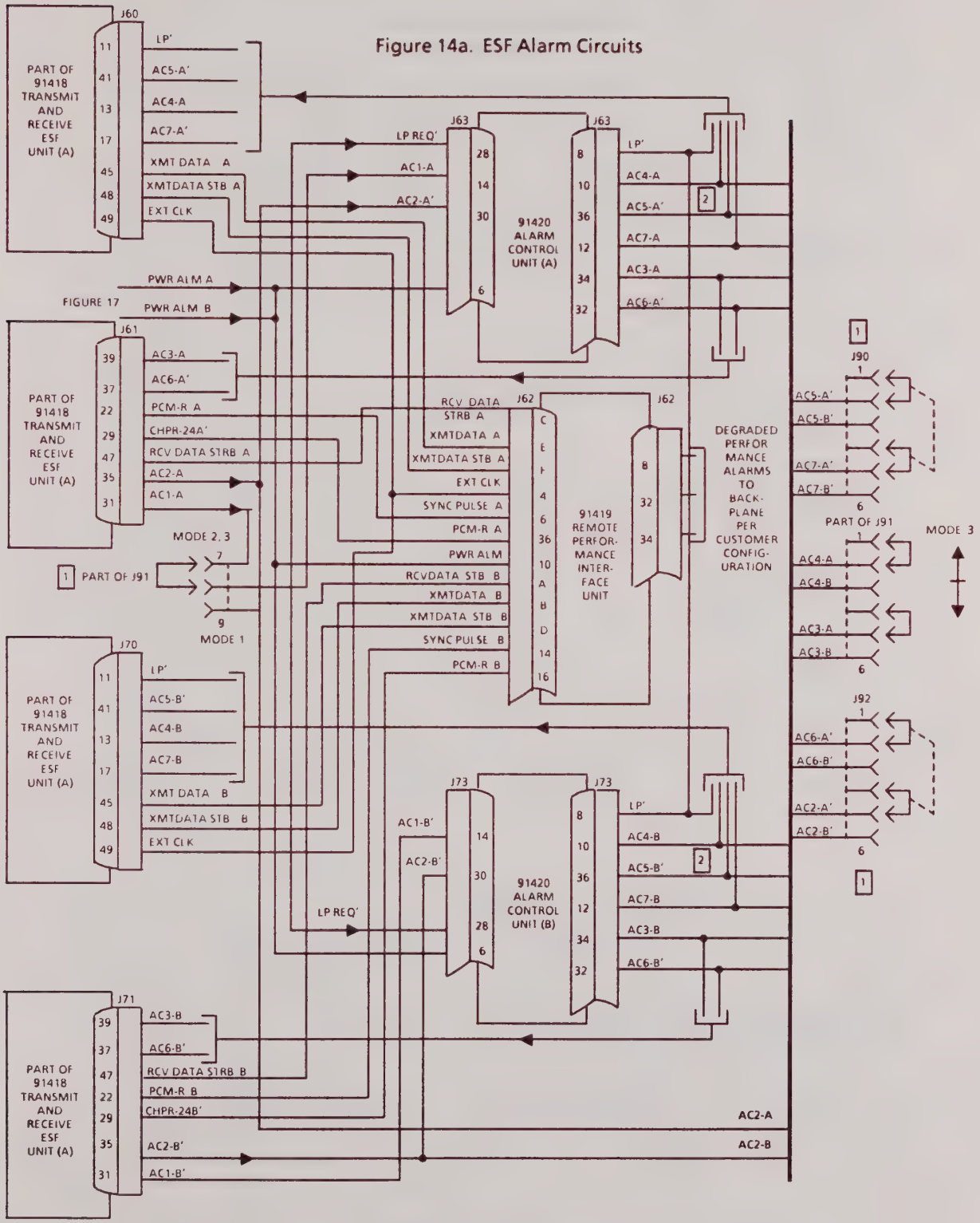


Figure 14. Alarm Circuits (Sheet 1 of 3).

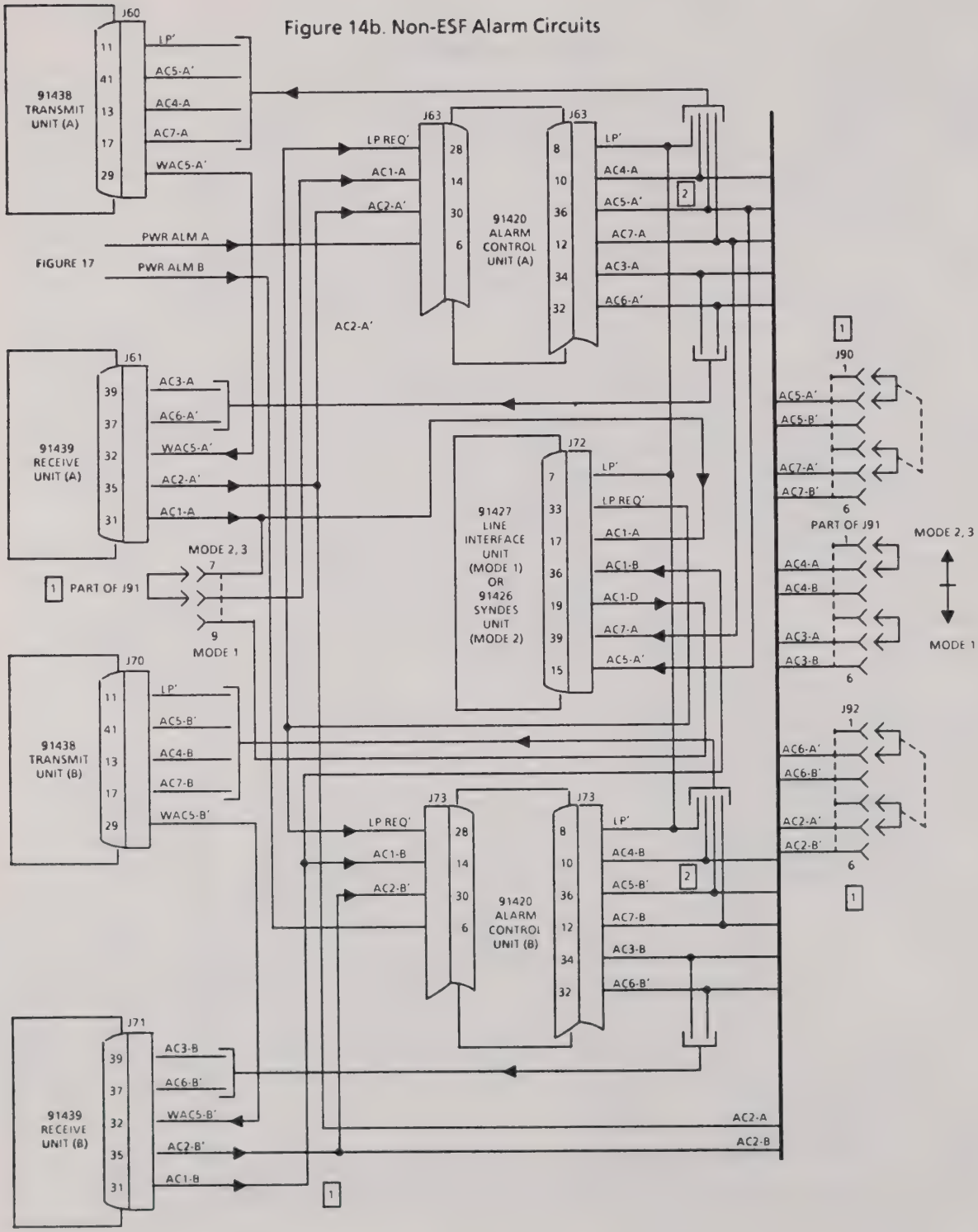
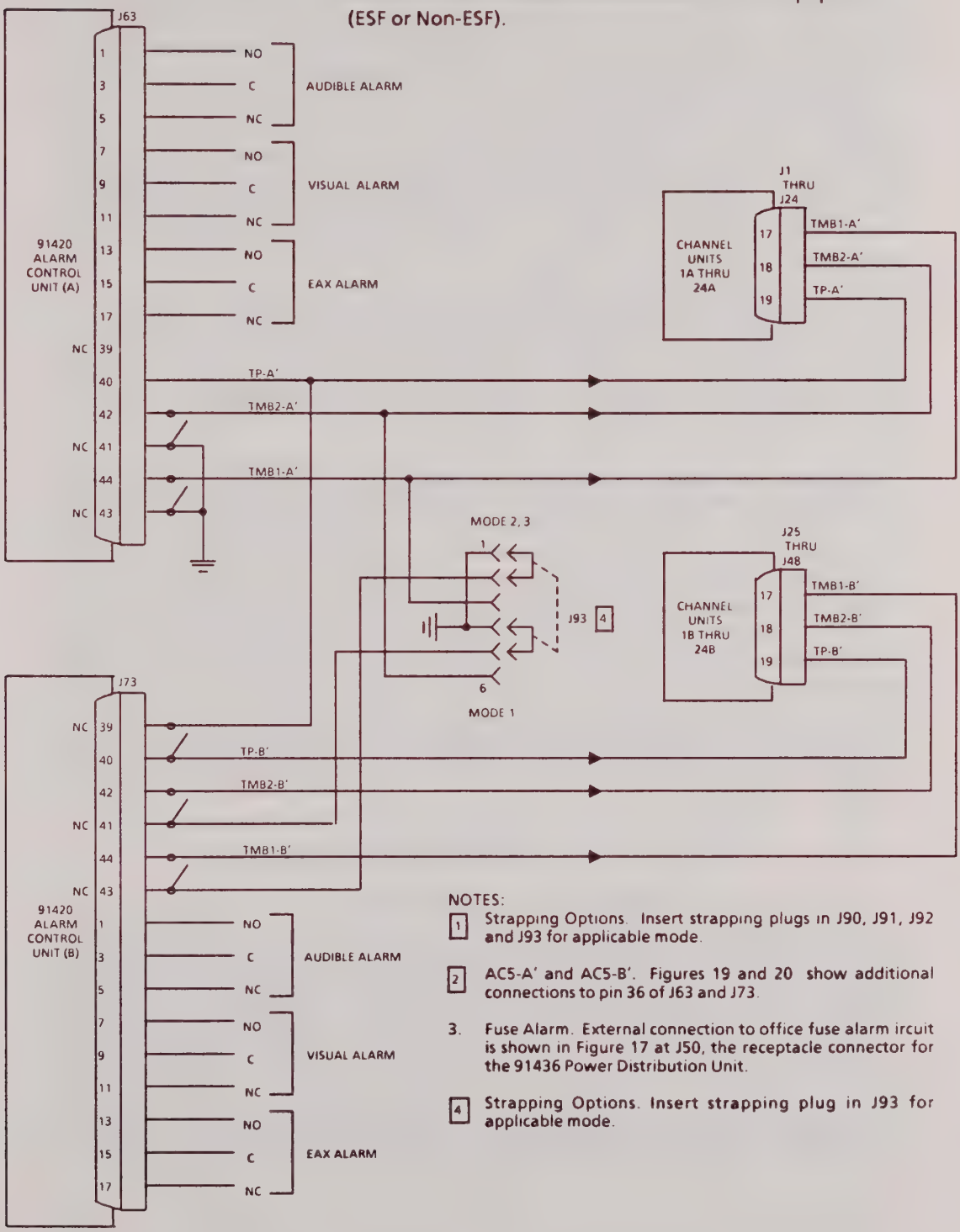


Figure 14. Alarm Circuits (Sheet 2 of 3).

FIGURE 14c. Alarm Circuits - External Connection to Alarm Equipment (ESF or Non-ESF).



NOTES:

1. Strapping Options. Insert strapping plugs in J90, J91, J92 and J93 for applicable mode.
2. AC5-A' and AC5-B'. Figures 19 and 20 show additional connections to pin 36 of J63 and J73.
3. Fuse Alarm. External connection to office fuse alarm ircuit is shown in Figure 17 at J50, the receptacle connector for the 91436 Power Distribution Unit.
4. Strapping Options. Insert strapping plug in J93 for applicable mode.

Figure 14. Alarm Circuits (Sheet 3 of 3).

3.16 Alarm leads AC1 through AC7 (Figure 14, sheets 1 and 2) are established for Mode 1 or Mode 2/3 by four strapping plugs inserted in J90 through J93. Timing signals (Figure 14, sheet 3) are established for Mode 1 or Mode 2/3 by another strapping plug in J93 and by switching contacts on connector J73. The contacts on J73 are closed in Mode 1 when ACU B is not equipped.

3.17 Figure 15 has simplified diagrams showing alarm circuit variations in Modes 1, 2, and 3 for ESF and non-ESF common equipment. The diagrams include the effect of properly inserted strapping plugs and closed switching contacts on J73. Alarm inputs are in Figure 15a and timing signals are in Figure 15b.

3.18 With the channel bank in a system alarm or TMB hold condition, and the ACO relay operated, the bank is placed in looped terminal (LT) status by depressing the LOOP pushbutton on either or both alarm control units. Figure 15c gives partial diagrams of the loop control circuits in Modes 1, 2, and 3.

3.19 Referring to the Mode 2 diagram in Figure 15c, with either digroup in LT status, a loop pulse request (LP Req') is made by depressing the TEST pushbutton on the syndes unit. In response, the alarm control unit of the digroup in LT status outputs a 300-ms LP' pulse. The LP' pulse operates a relay in the syndes unit that loops the DS1C line signal, transmit to receive. The pulse also inhibits gate 5 in the transmit unit, unlooping the digroups(s) in the transmit and receive units. For a more detailed explanation, refer to the functional description of the unit involved.

3.20 Figure 15c also provides a diagram of the channel bank in local loop using the ACO pushbutton on the alarm and control unit.

NOTE: In addition to local loop, the 91419 RPIU allows activation of remote loop, path loop, and payload loop.

External Channel Unit Connections

3.21 VF and signaling/supervisory leads (Figure 16) are wired from four pin-pairs on 24 channel units to four 50-pin male connectors, J101-J104 for digroup A and J201- J204 for digroup B. The leads are extended to the office drop equipment via 25-pair cables. Figure 16a shows the wiring from one pin-pair on the 24 channel units of a digroup to the associated 50-pin connector. The diagram is typical for pins 35/36, 37/38, 40/39, and 43/44, which are shown in Figures 16b and 16c. For example, pins 37/38 of channels 1A through 24A are wired to J101; pins 40/39 of channels 1B through 24B are wired to J204.

3.22 On the 91430-11 shelf, channel unit pins 33/34 are wired to two additional 50-pin connectors, J105 in digroup A and J205 in digroup B.

3.23 Pins 41/42 and 43/44 of the channel unit receptacle connectors have switching contacts that are closed when no channel unit is plugged in. If ground is required on a C1, E, or C lead to busy a trunk toward the office when the channel unit is unplugged, a strapping plug is installed at wirewrap terminal B or A as described below. When not in use, the strapping plug is "parked" on terminal B.

NOTE: As viewed from the rear of the shelf, terminal A is to the right of pin 44 on all channel unit connectors except 1A, 1B, 13A, and 13B. For these channel unit connectors, two terminal A's are to the left of terminal B where they are more accessible.

(a) For ground on the C1 lead at pin 40, terminal B is strapped to pin 41.

(b) For ground on the E/C lead at pin 44 of any channel except 1A, 1B, 13A, or 13B, terminal A is strapped to pin 44 as shown in Figures 16b and 16c.

(c) For ground on the E/C lead at pin 44 of channel 1A, 1B, 13A, or 13B, the two terminal A's are strapped as shown in Figure 16d.

3.24 At a digital toll office, an FDM channel bank may interface a digital switch through a 9004B bank equipped with 91434 4W SF Channel Units. The TMB control lead from each 12-channel FDM group is wired to a terminal on the 91430 shelf labeled FDM TMB. As shown in Figure 16e, a bus connects the terminal to pin 20 of the 12 channel units on the same shelf level.

Power Supply and Distribution

3.25 Figure 17 shows the 91425 Power Supply Unit, the 91436 Power Distribution Unit (PDU), and the distribution of power in the terminal equipment shelf. Entering at terminal TB1-3, and going through PS fuse F8 on the PDU, power from the -48V office battery is converted by the power supply unit to +5V, -5V, +12V, and -12V supplies. Office battery is also distributed through SIG fuses F6 and F7 as Sig Bat A and Sig Bat B to digroups A and B.

3.26 The Fuse Alarm (FA) bus is energized by any blown fuse except F5. With -48 volts on the FA bus, the FUSE ALM indicator lights and relay K1 operates to turn on the office fuse alarm.

3.27 When required by DPO and FXS channel units, talking battery from TB1-4 via TALK BAT fuses F1 and F2 is filtered in the PDU and distributed to digroups A and B. If the office does not have talking battery, office battery at TB1-3 is strapped to TB1-4.

NOTE: Both TALK BAT fuses must be removed before the PDU is plugged into the shelf. Otherwise, the printed circuit connector on the PDU will be damaged by a current surge charging the 8300-μF filter capacitors. When the PDU is unplugged, the capacitors discharge slowly through 4700-ohm resistors.

3.28 If a TALK BAT fuse blows, the voltage drop across 250-ohm resistor R1 or R2 turns on transistor Q1 or Q2. The TALK FUSE ALM indicator lights and the FA bus is energized. Diodes CR1 and CR2 prevent the indicators from lighting when the blown fuse is other than F1 or F2.

3.29 When required by FXS channel units, a 20-Hz ringing supply from TB1-5 is distributed through fuses F3 and F4 to digroups A and B. If either fuse blows, a half-wave rectifier (CR3) produces negative 48 volts on the FA bus.

3.30 The Pwr Alm lead from the 91425 Power Supply Unit is connected through a 10k ohm pullup resistor to + 5V in each 91420 Alarm Control Unit. In normal condition, the 30-volt zener diode in the 91425 unit conducts, and the voltage on the Pwr Alm lead is negative. If any of the four 91425 output voltages drop below a preset value, transistor Q204 turns on. The red ALM indicator lights, the zener diode cuts off, and the Pwr Alm lead goes to logic 1.

3.31 External rack ground and battery ground connections are made at terminals TB1-1 and TB1-2. If battery ground must be isolated from frame ground, the electrical clip (strap) between TB1-1 and -2 is removed. Within the shelf, TB1- 1 is connected to the chassis at one point only, and the battery ground distribution from TB1-2 is floating. Signaling ground has a separate distribution, which is connected to frame ground at TB1-1 only.

Channel Pulse Distribution

3.32 The transmit unit generates 24 transmit channel pulse signals, one to each channel unit in the digroup. Similarly, the receive unit generates 24 receive channel pulse signals. Figure 18 diagrams the distribution circuits to channel 1 in each digroup as typical. Designations and connector pin numbers for all 24 channels are tabulated next to the diagrams.

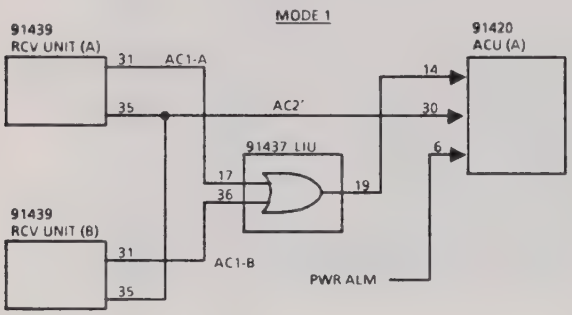
Interface Units

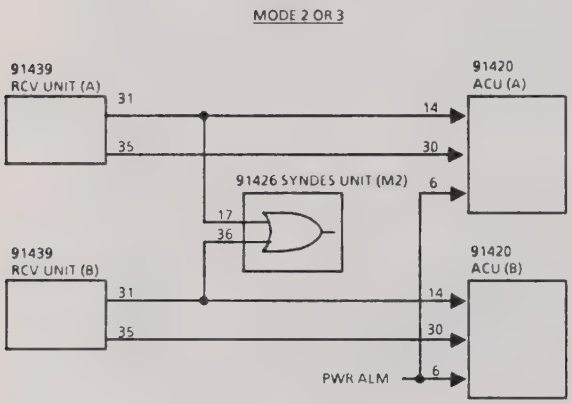
3.33 The 91419 Remote Performance Interface Unit (RPIU) (Figure 19) and the 91448 Office Interface Unit (OIU) (Figure 20) monitor local alarm (AR'), remote alarm (AY'), and power alarm status. Alarm indications from the 91448 unit can be sent to a distant location via an external supervisory system. The 91419 provides an RS-232-C interface (via the 91430 shelf backplane) that is used to connect a Cathode Ray Tube (CRT) which allows the user to program and query the system and receive history and alarm messages. An RS-422 port (TBOS interface) is also provided for connection to an Operational Support System (OSS) In addition, alarm cutoff and loop relays in the ACU's can be controlled from the distant location. In a system alarm, closure between ACO1 and ACO2 operates the alarm cutoff relay; closure between AC5' and ExtLp operates the loop relay.

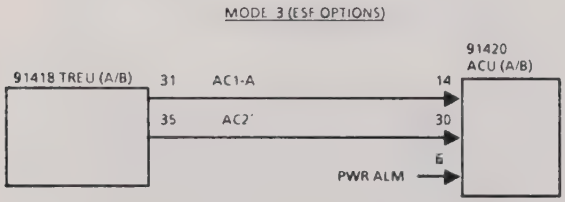
3.34 The RPIU also has a Degraded Performance (DP) set of alarm contacts (Figure 19). The leads associated with DP alarms are designated DEGPNC and DEGPNO. DP alarm thresholds can be programmed or the RPIU can be programmed not to sound DP alarms. Refer to the 9004B ESF User's Guide (Section 342-911-550) for information on programming DP alarm thresholds.

3.35 The 91419 RPIU and the 91448-02 OIU supply two sync signals to the OCUDP and DS0DP data channel units. The composite clock at pins 38 and 42 of J62 may be to or from a RPIU or -02 OIU in another channel bank, or it may be from an office composite clock source. When the clock is an output, it and the two sync signals are synchronized with the incoming digital signal by receive channel pulse ChPR-24A' or -24B'.

FIGURE 15a. ALARM CONTROLS AC1 AND AC2'







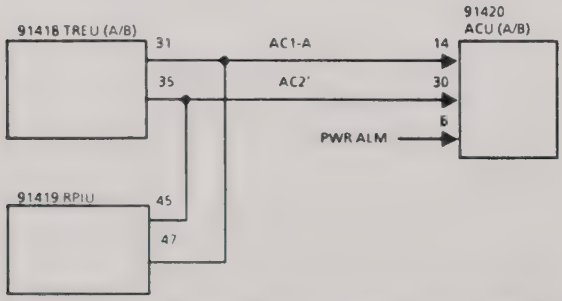
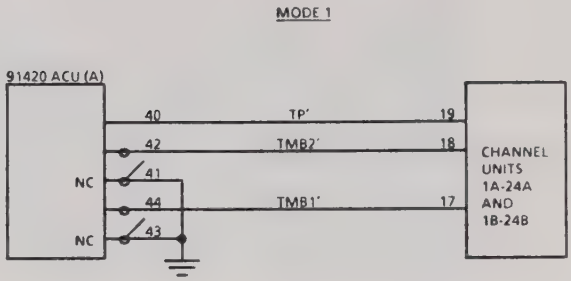


FIGURE 15b. TIMING SIGNALS TP', TMB1', AND TMB2'



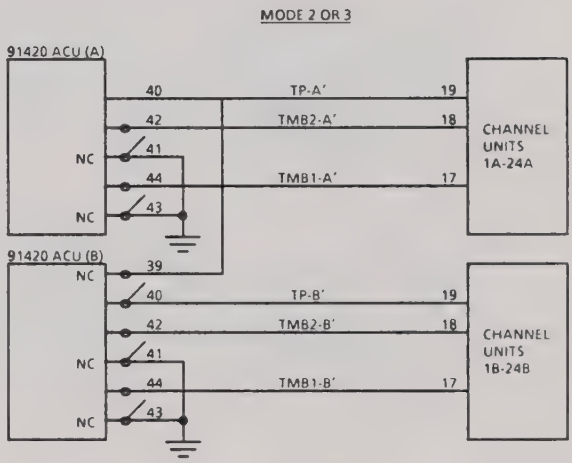


Figure 15. Circuit Variations in Modes 1, 2, and 3 - Simplified Diagrams (Sheet 1 of 2).

FIGURE 15c. LOOP CONTROLS AC5' AND WAC5'

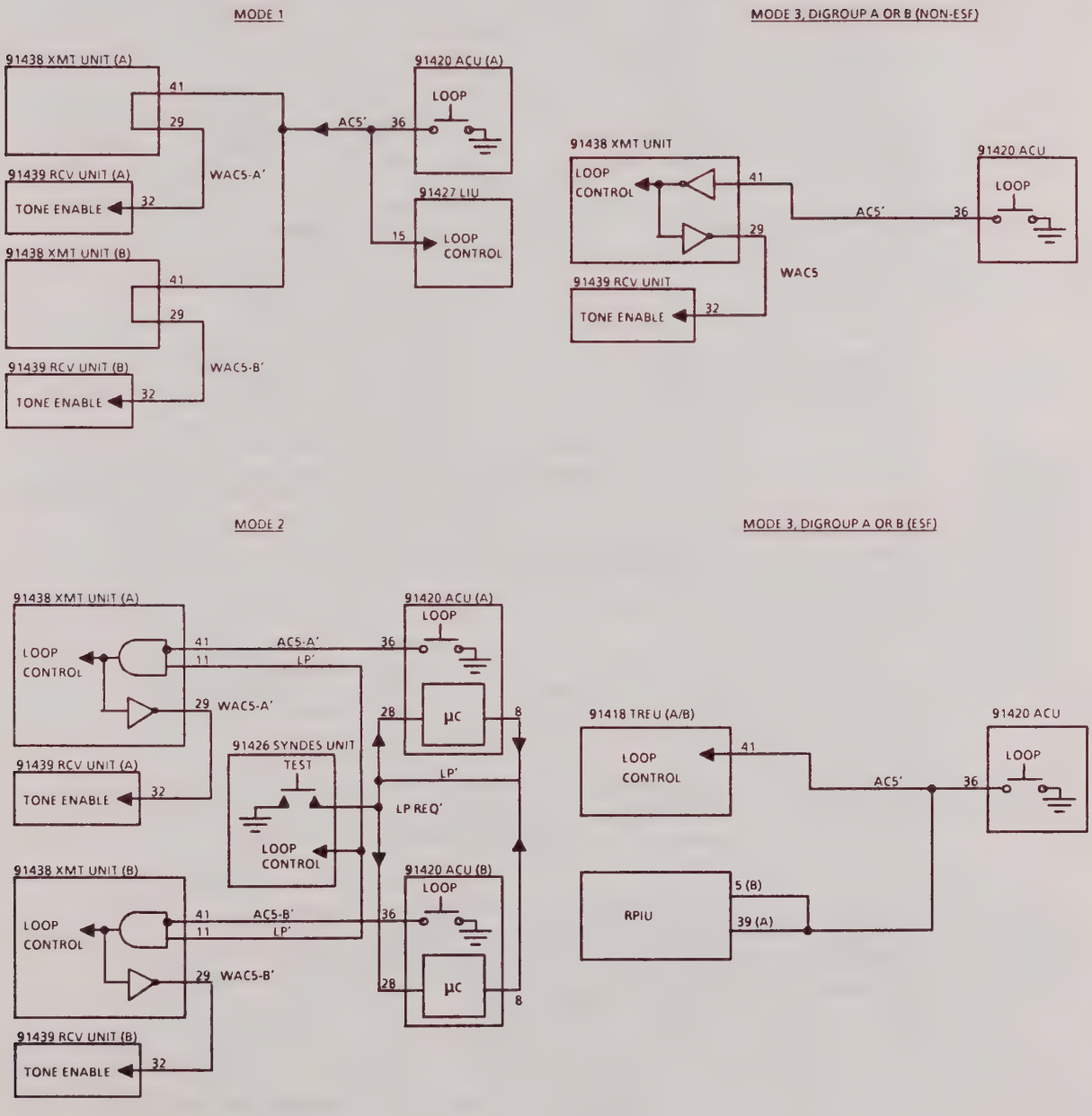


Figure 15. Circuit Variations in Modes 1, 2, and 3 - Simplified Diagrams (Sheet 2 of 2) .

FIGURE 16a. TYPICAL WIRING TO ONE PIN-PAIR ON 24 CHANNEL UNITS, DIGROUP A OR B

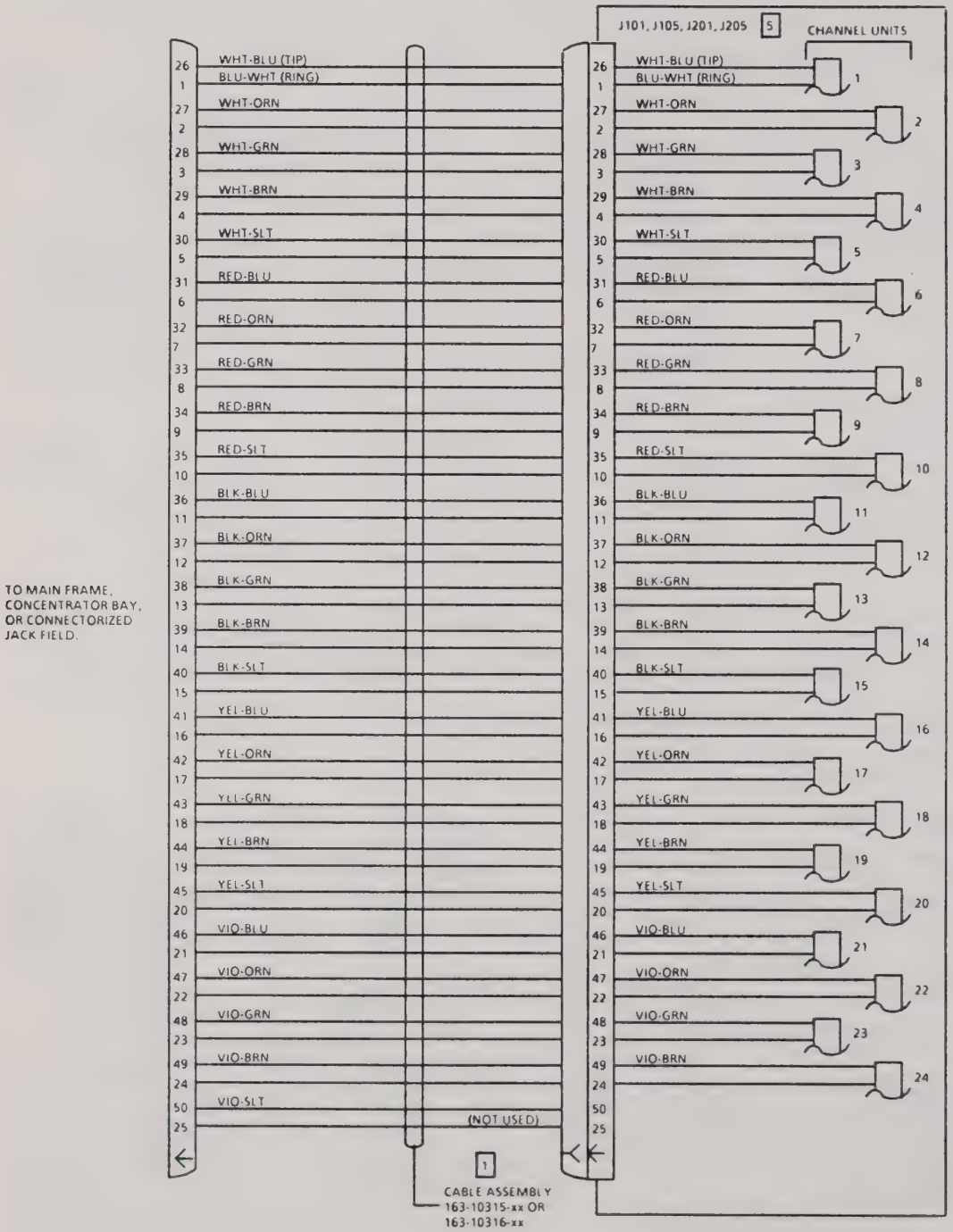


Figure 16. External Channel Unit Connections (Sheet 1 of 3).

FIGURE 16b. WIRING TO DIGROUP A CHANNEL UNITS

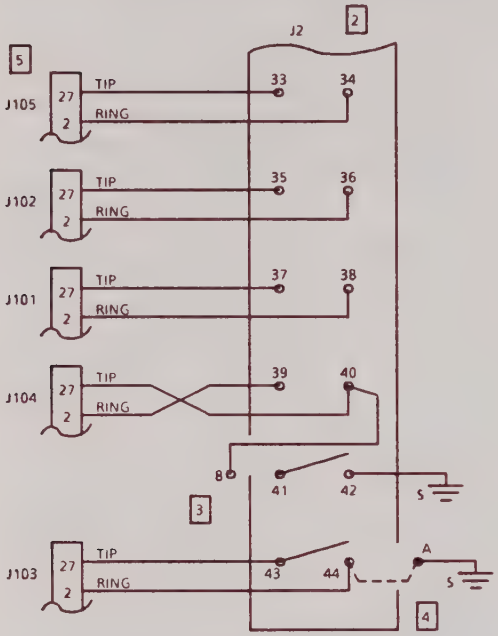


FIGURE 16c. WIRING TO DIGROUP B CHANNEL UNITS

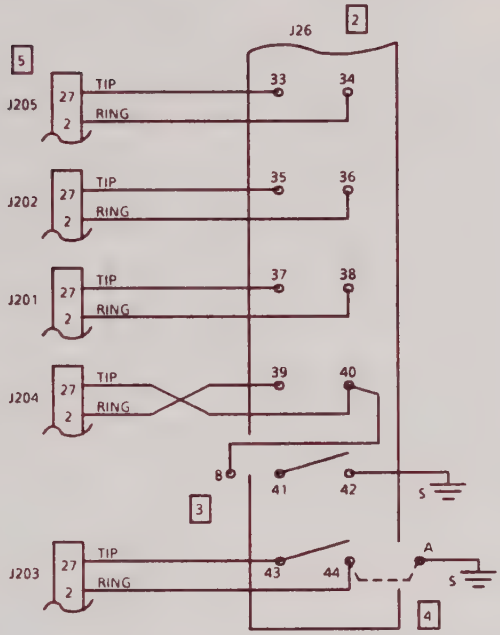


FIGURE 16d. TERMINAL "A" STRAPPING. CHANNEL UNITS 1A, 13A, 1B, AND 13B

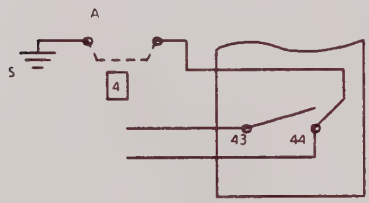


FIGURE 16e. FDM TMB BUSES [7]

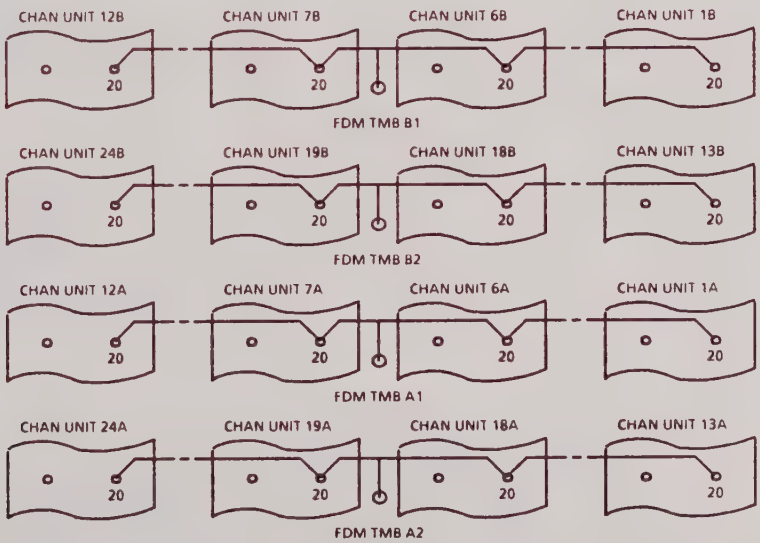


Figure 16. External Channel Unit Connections (Sheet 2 of 3).

FIGURE 16f. FUNCTIONAL DESIGNATIONS OF CHANNEL UNIT LEADS

CHANNEL UNIT	PIN NO. (TIP/RING) ON J1-J24 (DIGROUP A) AND J25-J48 (DIGROUP B)									
	33/	34	35/	36	37/	38	40/	39	43/	44
91401 4W			T	R	T1	R1				
91402 2W E&M			A	B	T1	R1	C1, F, SB	M	E	SG
91403-01 SDPO [6]			T1	R1	T1	R1	EC, PC	ATB	B1, C	B2
91403-11 SDPO [6]		PC	T1	R1	T1	R1	EC, PC	ATB	B1, C, OS, S	B2
91404 4W E&M			T	R	T1	R1	C1, F, SB	M	E	SG
91405 DPT					T1	R1			C	
91407-01 4W TANDEM			T	R	T1	R1	M2	M1	E1	E2
91407-12 4W TANDEM			T	R	T1	R1		EX	E	SG
91408 2W FXO					T1	R1			C	
914092W FXS					T1	R1			C	
91411 4W LOOP SIMPLEX ORIG			T	R	T1	R1				
91412 5/8 KHZ PROGRAM XMT			T	R						
91413 5/8 KHZ PROGRAM RCV					T1	R1				
91414 8/15 KHZ PROGRAM XMT			T	R						
91415 8/15 KHZ PROGRAM RCV					T1	R1				
91434 4W SF			T	R	T1	R1				
91450 STOP DIAL/WINK ORIG	BSY-1	SYN			+L	−L	EC	ATB	C	
91451 4W			T	R	T1	R1				
91452 2W E&M			A	B	T1	R1	C1, F, OS, SB	M	E	SG
91454 4W E&M			T	R	T1	R1	C1, F, OS, SB	M	E	SG
91458-01/-11 2W FXO					T1	R1			C	
91459-01/-11 2W FXS					T1	R1	RMS			
91458-12 2W FXO with GT					T1	R1				
91459-12 2W FXS with GT					T1	R1				
91460, 91461, 91462, 91463 OCUDP			T	R	T1	R1				
91464, 91465 DS0DP			T	R	T1	R1				
91466 AR-OCUDP			T	R	T1	R1				
91467 AR-DS0DP			T	R	T1	R1				
91468 AR-DSUDP			T	R	T1	R1				
91470 DPO/ICT					T1	R1				
91471 DPT/OGT					T1	R1				
91478 4W FXO			T	R	T1	R1				
91479 4W FXS			T	R	T1	R1				

NOTES;

[1] External Cabling. In Figure 16a, cable assembly 163-10315-xx is unterminated at the drop end. Cable assembly 163-10316-xx is terminated in a male connector as shown.

[2] Figures 16b and 16c are typical for digroup a and b channel units. Pin numbers 27/2 on J101-J105 and J201-J205 are for channels 2a and 2b. See figure a for pin numbers applicable to other channels. See Figure 16f for functions

[3] Switching Contacts. Pins 41/42 and 43/44 have switching contacts that are closed when no channel unit is plugged in.

[4] Strapping. Dash lines in Figures 16b, 16c, and 16d indicate factory strapping made with strapping plug 140-56463-01.

[5] 91430-11 And -01 Shelves. Connectors j105 and j205 and the wiring to channel units pins 33/34 are provided on the 91430-11 shelf but not on the 91430-11 shelf.

[6] 91403 DPO Channel Unit. The two wire port at pins 35/36 has nonreversing battery, positive at T1 and negative at R1.

[7] FDM TMB. In Figure 16f, each FDM TMB terminal is bused to pin 20 of the 12 channel units on the same shelf level

Figure 16. External Channel Unit Connections (Sheet 3 of 3).

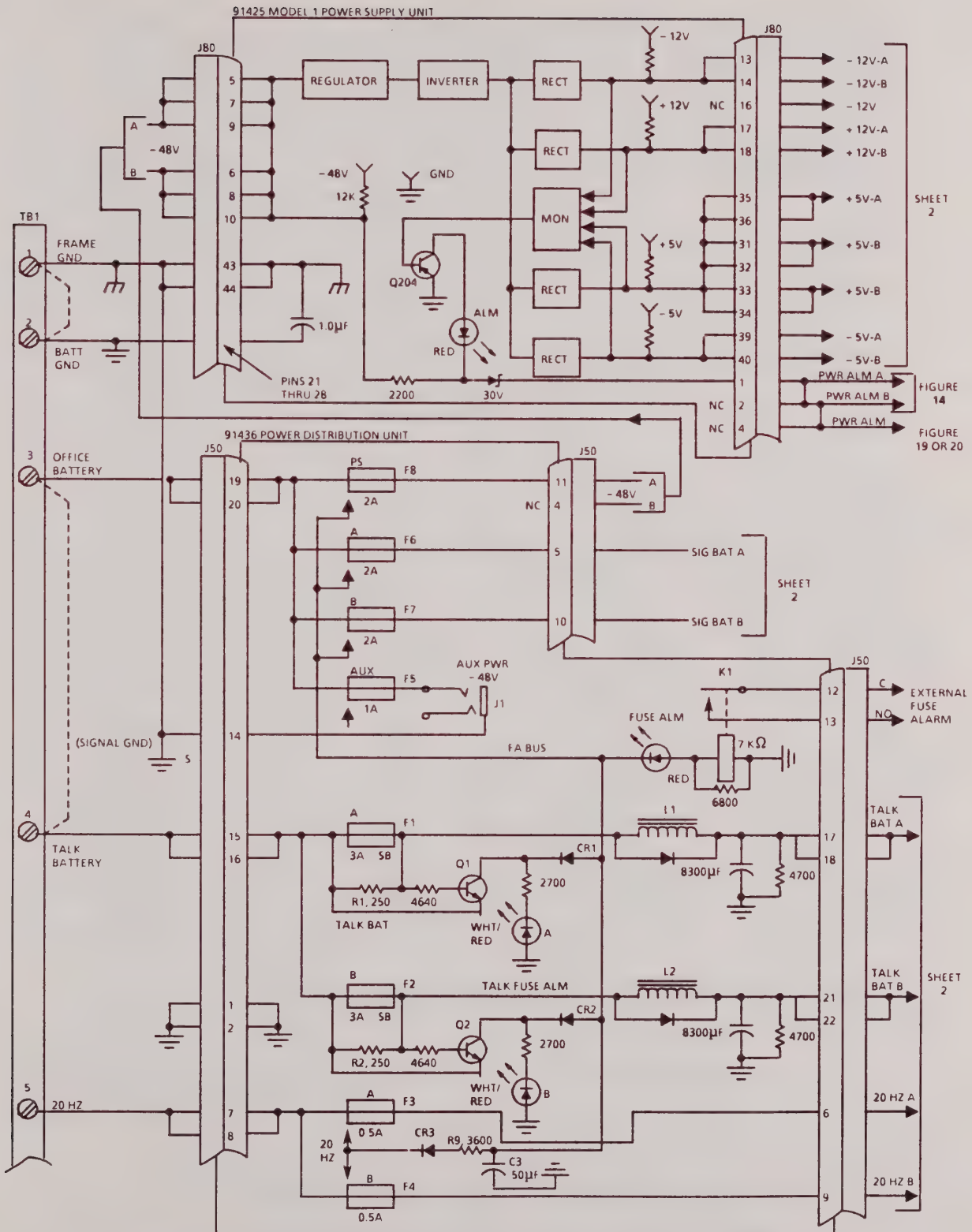


Figure 17. Power Distribution - 91425 and 91436 Units (Sheet 1 of 2).

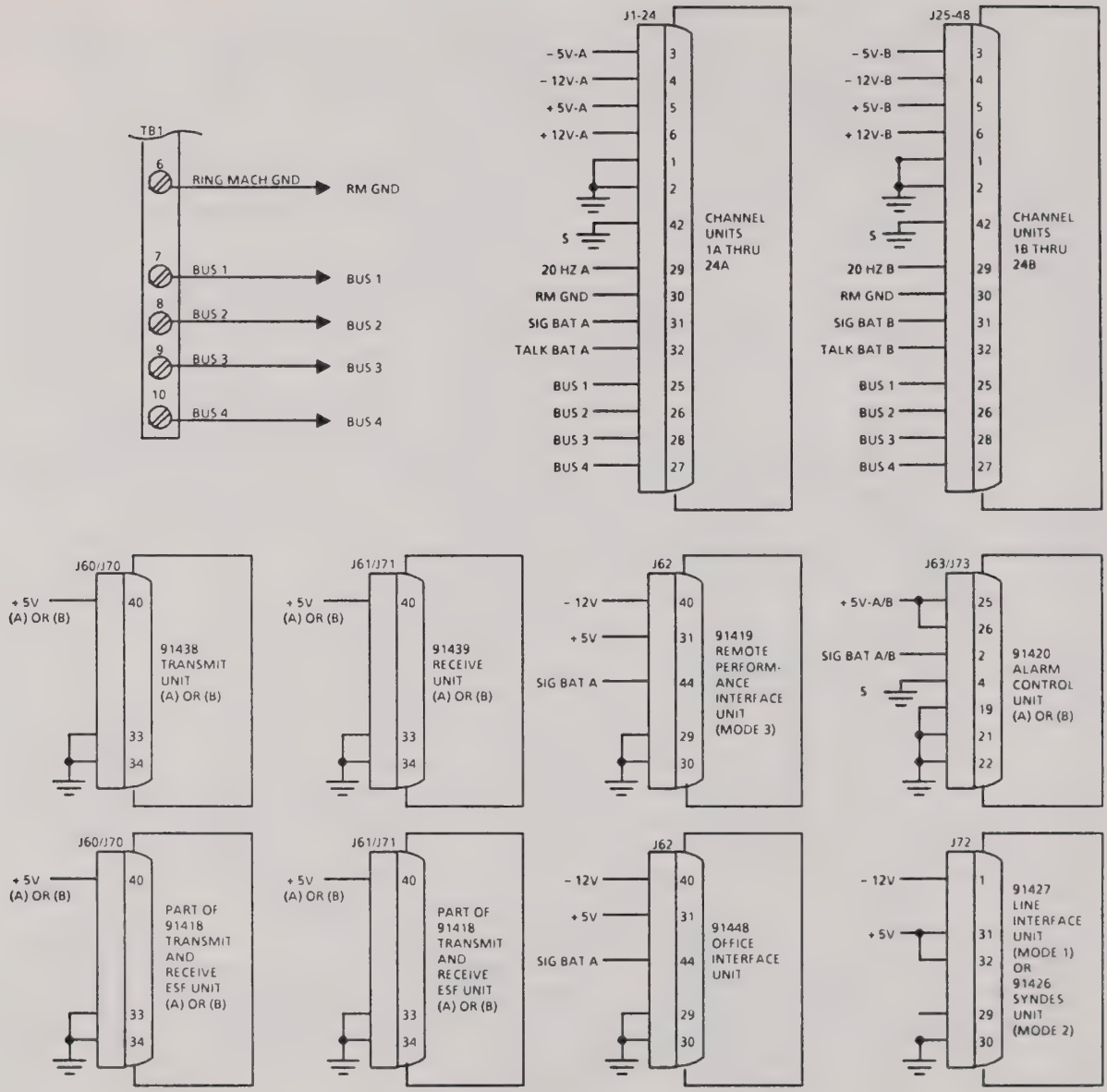
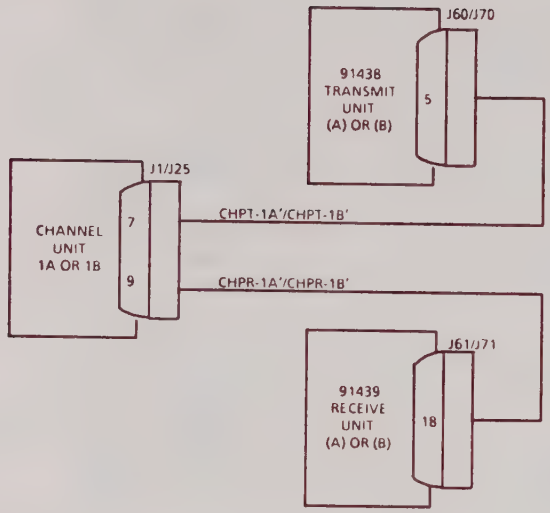
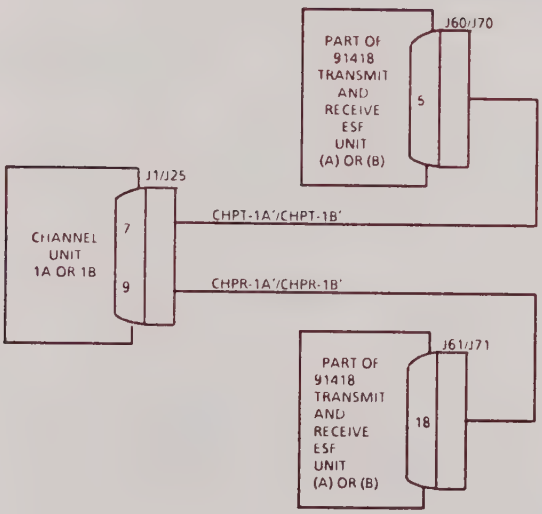


Figure 17. Power Distribution - 91425 and 91436 Units (Sheet 2 of 2).



TRANSMIT CHANNEL PULSE	TO PIN 7 OF	FROM J60, PIN
CHPT -1A'	J1	5
-2A'	J2	3
-3A'	J3	1
-4A'	J4	4
-5A'	J5	2
-6A'	J6	6
-7A'	J7	8
-8A'	J8	10
-9A'	J9	12
-10A'	J10	14
-11A'	J11	16
-12A'	J12	15
-13A'	J13	50
-14A'	J14	46
-15A'	J15	44
-16A'	J16	42
-17A'	J17	40
-18A'	J18	38
-19A'	J19	36
-20A'	J20	32
-21A'	J21	30
-22A'	J22	28
-23A'	J23	21
-24A'	J24	18

RECEIVE CHANNEL PULSE	TO PIN 9 OF	FROM J61, PIN
CHPR -1A'	J1	18
-2A'	J2	16
-3A'	J3	14
-4A'	J4	12
-5A'	J5	10
-6A'	J6	8
-7A'	J7	6
-8A'	J8	4
-9A'	J9	2
-10A'	J10	1
-11A'	J11	3
-12A'	J12	5
-13A'	J13	7
-14A'	J14	9
-15A'	J15	11
-16A'	J16	13
-17A'	J17	15
-18A'	J18	17
-19A'	J19	19
-20A'	J20	21
-21A'	J21	23
-22A'	J22	25
-23A'	J23	27
-24A'	J24	29 [1]



TRANSMIT CHANNEL PULSE	TO PIN 7 OF	FROM J70, PIN
CHPT -1B'	J25	5
-2B'	J26	3
-3B'	J27	1
-4B'	J28	4
-5B'	J29	2
-6B'	J30	6
-7B'	J31	8
-8B'	J32	10
-9B'	J33	12
-10B'	J34	14
-11B'	J35	16
-12B'	J36	15
-13B'	J37	50
-14B'	J38	46
-15B'	J39	44
-16B'	J40	42
-17B'	J41	40
-18B'	J42	38
-19B'	J43	36
-20B'	J44	32
-21B'	J45	30
-22B'	J46	28
-23B'	J47	21
-24B'	J48	18

RECEIVE CHANNEL PULSE	TO PIN 9 OF	FROM J71, PIN
CHPR -1B'	J25	18
-2B'	J26	16
-3B'	J27	14
-4B'	J28	12
-5B'	J29	10
-6B'	J30	8
-7B'	J31	6
-8B'	J32	4
-9B'	J33	2
-10B'	J34	1
-11B'	J35	3
-12B'	J36	5
-13B'	J37	7
-14B'	J38	9
-15B'	J39	11
-16B'	J40	13
-17B'	J41	15
-18B'	J42	17
-19B'	J43	19
-20B'	J44	21
-21B'	J45	23
-22B'	J46	25
-23B'	J47	27
-24B'	J48	29 [1]

NOTE: [1] Channel 24. Figures 19 and 20 show additional distribution of CHPR-24A' and CHPR-24B' to the 91419 and 91448 interface units.

Figure 18. Channel Pulse Distribution.

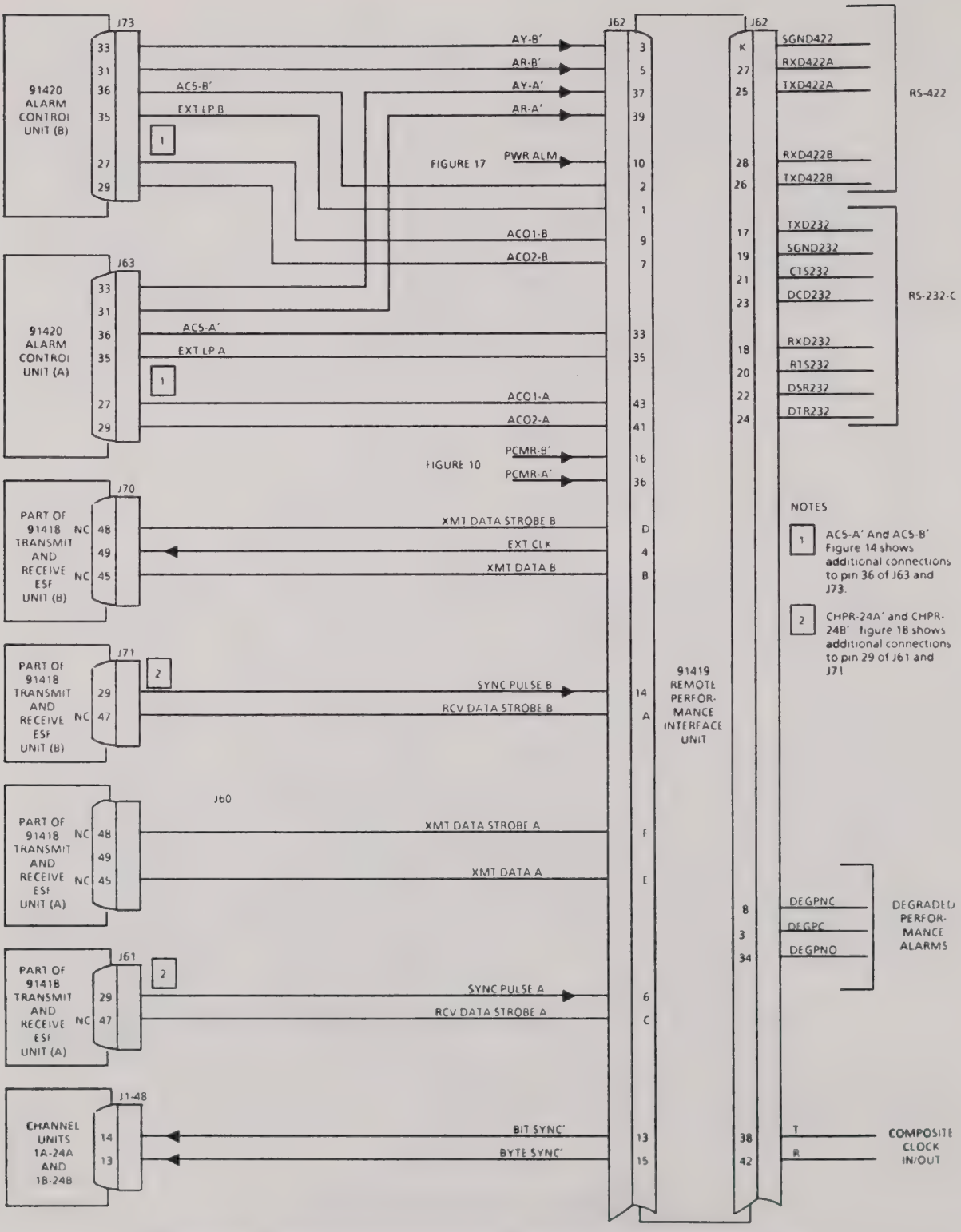


Figure 19. Internal and External Connections to 91419 RPIU.

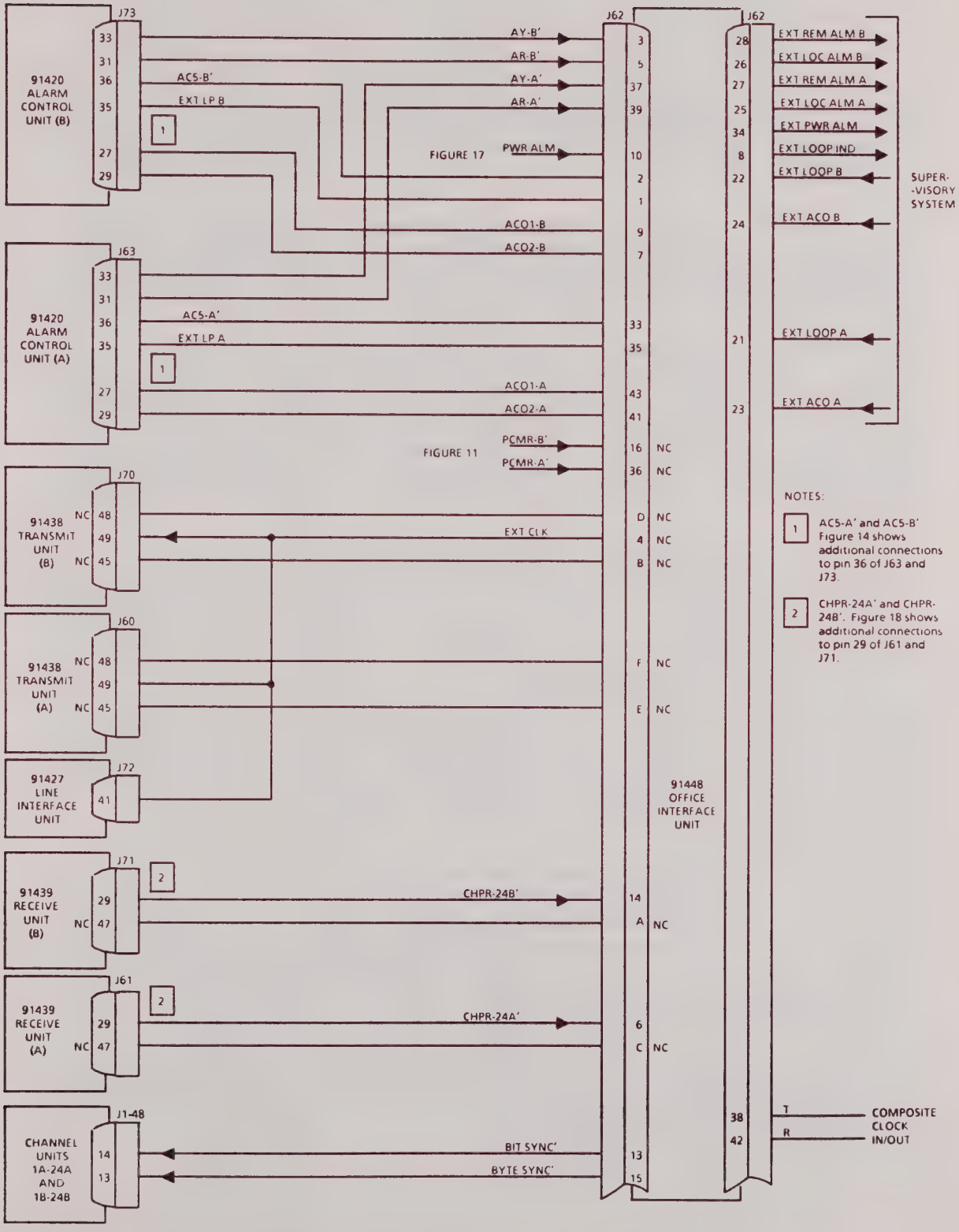


Figure 20. Internal and External Connections to 91448 OIU.

4. CHANNEL UNITS

VF Channel Units

4.01 Figure 21 is a generalized diagram of the main transmission paths through a channel unit. Except for the two-wire vs four-wire differences, the circuits shown are basically the same for all trunk and special service VF channel unit types.

4.02 **VF Levels.** Transmission levels at the VF interface with the office equipment are set by inserting strapping plugs in the transmit and receive attenuators. There are no variable controls to be adjusted and no test points at standard Transmission Level Points (TLP's).

4.03 For the ordinary non-tandem applications of a four-wire channel unit, the transmit/receive drop levels are set at -16/+7 dBm by strapping the tandem attenuators for 0 dB and the 6.3-dB step attenuators for 1.5 dB. From these setting, in 0.1-dB steps, the step attenuators can be decreased 1.5 dB to compensate for office loss or increased 4.8 dB to adjust insertion loss. The adjustment ranges at each setting of the tandem attenuators are summarized in Table 6.

4.04 Figure 21 compares VF levels in four-wire channel units of the 9004A/B channel banks. Assuming 0.3 dB office loss, the transmit and receive attenuators on the channel units are set at 1.2 dB to obtain -16/+7 TLPs at the toll test board. (The attenuator setting for 0 dB office loss is 1.5 dB as mentioned in the preceding paragraph.)

4.05 The test setups with a 9004A/B channel unit are shown in Figure 22 are described below. Assume the DS1/DS1C signal is looped back at the line so that the test tone is transmitted and received on the same channel. For end-to-end testing, the same setup at each terminal is required.

Table 6. Typical Four-Wire VF Drop Levels.

	Applications and (Tandem Attenuator Setting, dB)	Level Range, dBm
Four Wire Transmit	Non-tandem (0) Special (6.4) Special (12.8) Tandem	-17.5 to -11.2 -11.1 to -4.8 -4.7 to +1.6 +4.5 to +10.8
Four Wire Receive	Non-tandem (0) Special (6.4) Special (12.8) Tandem (23)	+8.5 to +2.2 +2.1 to -4.2 -4.3 to -10.6 -14.5 to 20.8

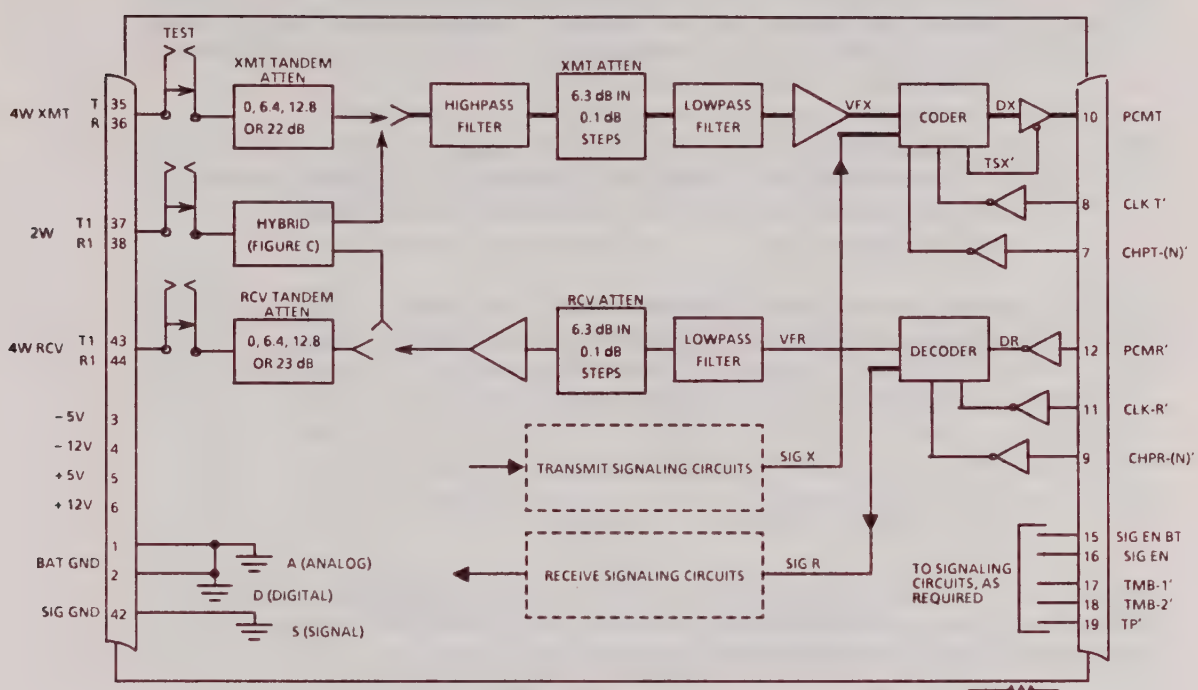
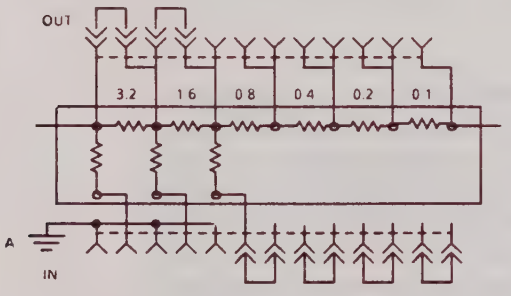


FIGURE 21c TYPICAL TWO-WIRE/FOUR-WIRE HYBRID CIRCUIT

FIGURE 21a 6 3-dB STEP ATTENUATOR STRAPPED FOR 1.5 dB



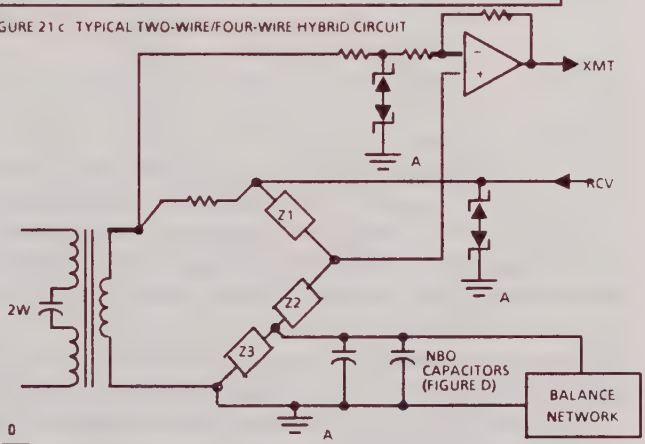


FIGURE 21b. TYPICAL TANDEM ATTENUATOR STRAPPED FOR 0 dB

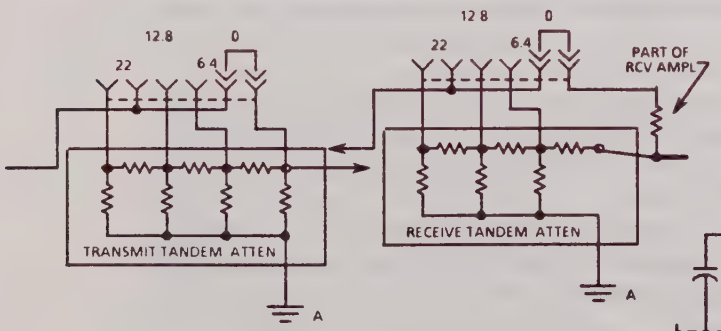


FIGURE 21d NBO CAPACITORS STRAPPED FOR 0.082 µF

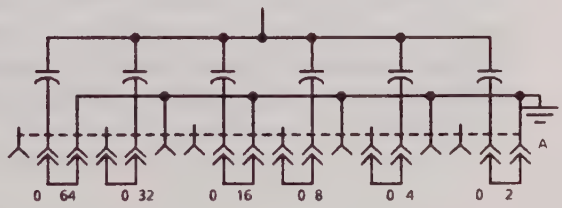


Figure 21. Channel Unit Circuit Diagram - Generalized Form.

(a) The 91232 test set is used to test a 9004A/B channel unit as shown in the first setup. Here, the tone goes through the transmit and receive attenuators set at 1.2 dB, and the four-wire receive level measures +7.6 dBm.

(b) The second setup tests a 9004A/B channel unit with a 91442 VF Test Set. Setting the test set attenuators at 1.2 dB compensates for the channel unit attenuators, and the acvm reads 0 dB as a normal indication.

4.06 On two-wire trunk channel units, for 0 dB office loss and 0/-3 TLPs at the drop, the 6.3-dB step attenuators are set at 4.5 dB transmit and 3.0 dB receive. By strapping the attenuators, VF drop levels are adjustable in 0.1-dB steps within the following ranges.

(a) Transmit: -4.5 to +1.8 dBm

(b) Receive: 0 to -6.3 dBm

4.07 On foreign exchange and some special-purpose channel units, the step attenuators have an additional 6.4-dB section that gives the following VF drop level adjustment ranges.

(a) Transmit: -10.9 to +1.8 dBm

(b) Receive: +2 to -10.7 dBm

4.08 Figure 21a shows a six-section 6.3-dB step attenuator, transmit or receive, strapped for 1.5 dB. A strapping plug must be inserted in the IN or OUT position of each section. Figure 21b shows the transmit and receive tandem attenuators strapped for 0 dB. A strapping plug must be inserted in one of the four positions of a tandem attenuator.

4.09 **Hybrid.** Figure 21c shows a typical configuration of the bridge circuit that serves as a two-wire to four-wire hybrid on two-wire channel units. The bridge is balanced by an internal compromise network or, on foreign exchange channel units, by one of several optional precision networks. These special internal precision networks, designed for particular gauges and loading arrangements of the VF cables, are strapped to improve balance over the channel frequency range. No provision is made for connection to external precision networks.

4.10 Through strapping plugs, six Network Buildout (NBO) capacitors can be paralleled to compensate for 0 to 0.126 μF office wiring capacitance in 0.002-μF (2-nanofarad) steps. See Figure 21d.

4.11 Hybrid performance is rated by transhybrid loss and return loss; for either parameter, higher loss (dB) means better performance. Transhybrid loss and various forms of return loss are defined as follows.

(a) **Transhybrid loss:** Measure of the signal loss from the four-wire receive port of the hybrid to the four-wire transmit port. It is equal to the sum of the four-wire return loss, the four-wire to two- wire receive insertion loss, and the two-wire to four-wire transmit insertion loss.

(b) **Four-wire return loss:** Measure of the impedance match between the two- wire drop and the balancing network.

(c) **Two-wire return loss:** Measure of the impedance match between a reference impedance and the impedance looking into the hybrid two-wire port. It is affected by the impedances at the four-wire transmit and receive ports but not the impedance of the balancing network.

(d) **Echo Return Loss (ERL) and Singing Return Loss (SRL):** Measure of the reflected energy at the near-end two-wire port plus any transhybrid energy returned from the far-end four-wire transmit port.

(1) ERL is the average weighted loss in the 500-2500 Hz band.

(2) SRL is the average weighted loss in the singing bands, 200-500 Hz and 2500-3200 Hz.

4.12 **Filters.** Channel unit VF filters are active types. In the transmit branch, the highpass and lowpass filters create a nominal passband of 180 to 3400 Hz with rolloff to -20 dB at the 60-Hz power line frequency. The receive lowpass filter, which has a 3400-Hz cutoff, reconstructs the VF signal from the stepped output of the decoder while blocking the 8-kHz sampling frequency and other out-of-band components. More-recently designed channel units combine the transmit and receive branch filters into a single integrated-circuit package.

4.13 **COMBO/CODEC.** Each channel unit has an integrated-circuit COMBO/CODEC (coder-decoder) with an internal voltage reference. In the transmit direction, during an assigned time slot, the coder samples the VF signal and converts the analog voltage into an eight-bit PCM digital word. After a one-frame delay, the coder outputs the eight bits serially to the transmit PCM bus (PCMT). This process is repeated at an 8,000-Hz frame rate. In frames 6 and 12 of a 12-frame interval called a superframe, the VF information in the least significant bit (bit 8) is suppressed and bit 8 conveys the channel signaling/supervisory status.

4.14 In the receive direction, the decoder performs a reciprocal function. During an assigned time slot, the channel word is clocked in from the receive PCM bus (PCMR') and converted to the sample voltage that was encoded by the far- end channel unit. From these discrete voltage steps, the lowpass filter reconstructs the original analog signal. Signaling bit 8 is latched in the decoder and updated each signaling frame.

4.15 **Quantization.** Figure 23 is a curve representing quantization of sample voltages by the coder. This segmented curve approximates a continuous compression law (μ-law) curve defined as:

$$y = \frac{Ln(1 + \mu x)}{Ln(1 = \mu)}$$

where x and y respectively are the coder input and output and $\mu = 255$ described below.

4.16 The curve has eight positive segments and eight negative segments with 16 steps in each segment, a total of 256 quantizing steps. Within each segment, the steps are uniform; in adjacent segments, according to the compression law, step sizes are in a 2/1 ratio with the smallest steps at the lowest signal levels.

4.17 In the coder, the sample voltage is compared with a reference voltage adjusted under logic control by the successive approximation method. In this method, the reference voltage is set at the halfway point on the portion of the curve where, based on results of preceding comparisons, the sample voltage is known to lie.

4.18 In the first comparison, the polarity of the sample is determined and encoded as bit 1 of the eight-bit PCM word; positive is logic 1 and negative is logic 0. Succeeding comparisons localize the sample voltage to one segment of the curve and encode the segment number as bits 2, 3, and 4. Then, the applicable step in that segment is found and the step number encoded as bits 5, 6, 7, and 8. The lowest-numbered bit is the most significant bit.

4.19 **Transmit Timing.** Each transmit unit supplies a single clock signal (ClkT') and 24 channel pulse signals, ChPT-1' through ChPT-24' to the digroup. (In mode 1 only, corresponding timing signals in digroups A and B are synchronized.) The transmit clock sets the bit rate and provides framing bit time slots, the channel pulse identifies the channel time slot, and the relative width of the channel pulse distinguishes between nonsignaling and signaling frames. Figure 24a is the transmit timing diagram.

4.20 The transmit clock has 192 active cycles per frame (8 bits x 24 channels = 192). Multiplying 192 by the 8-kHz frame rate gives 1.536 MHz. In mode 1, the transmit clock is blanked five cycles in each frame for framing bit insertion; the required clock frequency is therefore 1.536 MHz + 5 x 8 kHz = 1.576 MHz. In mode 3, the clock is blanked one cycle per frame and the required clock frequency is 1.536 MHz + 1 x 8 kHz = 1.544 MHz. The clock frequency in mode 2 is 1.544 MHz unless the looped receive clock option is used; then it is 1.576 MHz.

NOTE: The general channel pulse designation is ChPT-(n)' or ChPR-(n)' where n is the channel number. Channel n-1 and channel n + 1, respectively, refer to the channel that precedes and follows in the sampling sequence. (As listed in Table 3, the D3/D4 sequence is in channel number order, but the D2 and D1D sequences are not.)

4.21 The falling edge of channel pulse ChPT-(n)' occurs at bit 8 of channel n-1. The next active clock cycle defines the bit 1 time slot of channel n. The rising edge of the channel pulse occurs at bit 1 in nonsignaling frames or one clock cycle later at bit 2 in signaling frames.

4.22 In the transmit unit, framing bits are inserted in time slots preceding bit 1 of certain channels. The transmit clock is blanked one cycle at each framing bit time slot, stretching the channel pulses. Listed below are the widths of channel pulses in nonsignaling and signaling frames, respectively, for the D3/D4 sequence.

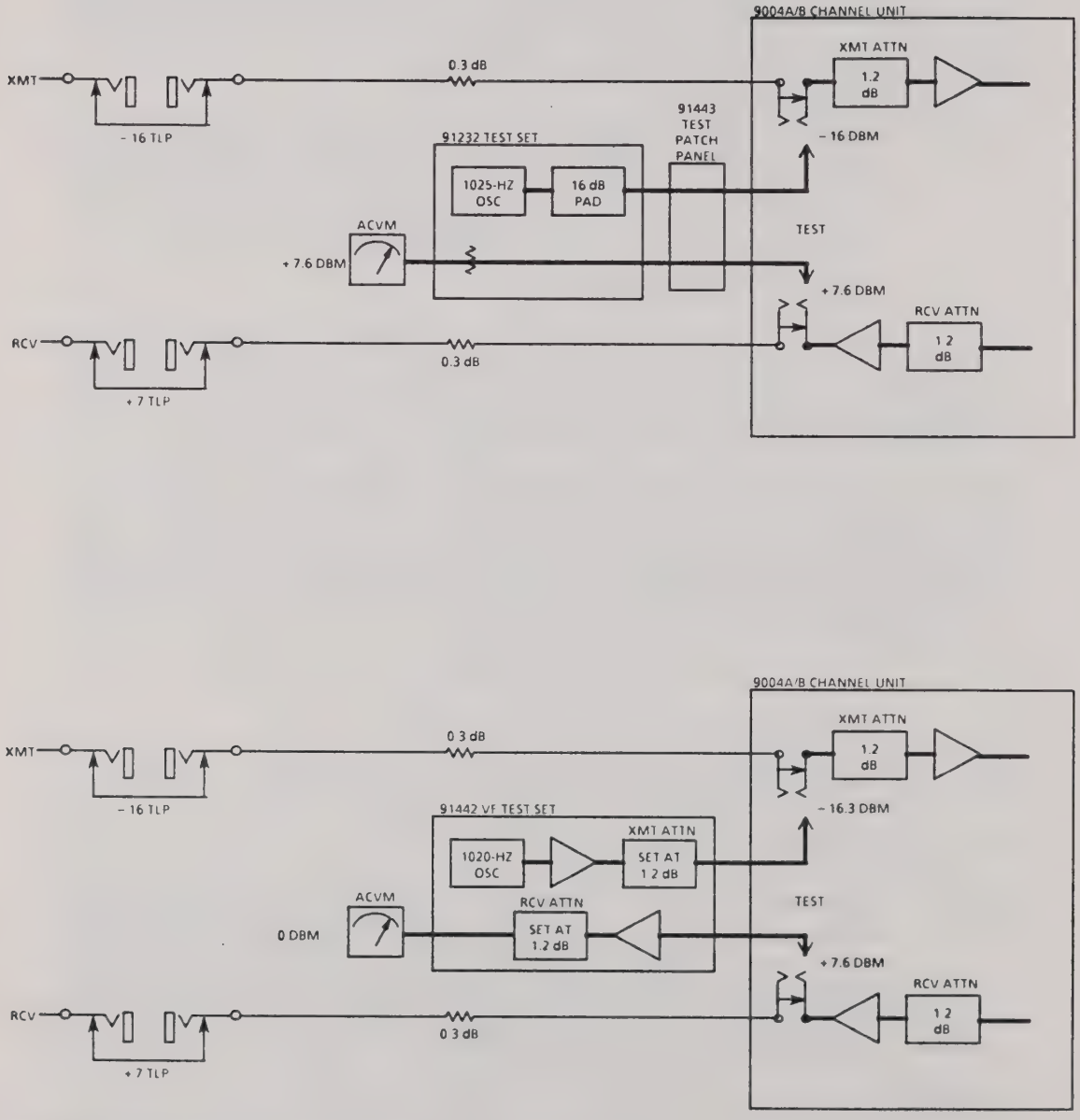
(a) Channel 2, mode 1: 3 and 4 cycles

(b) Channel 2, mode 2 or 3: 2 and 3 cycles

(c) Channels 8, 14, and 20, mode 1: 2 and 3 cycles

(d) All other channels: 1 and 2 cycles

NOTE: Because of delay in the transmit unit's zero code detector, the channel n PCM word is transmitted to the line while channel unit n + 1 is applying its PCM word to the PCMT bus. This is the reason that the clock is blanked during ChPT-2', for example, to create time slots for framing bits preceding channel 1. (The example refers to the D3/D4 sequence.)



NOTE: The above diagrams are typical examples. Refer to Section 342-911-134 for specific testing capabilities.

Figure 22. Four-Wire VF Levels in the 9004A/B Channel Banks.

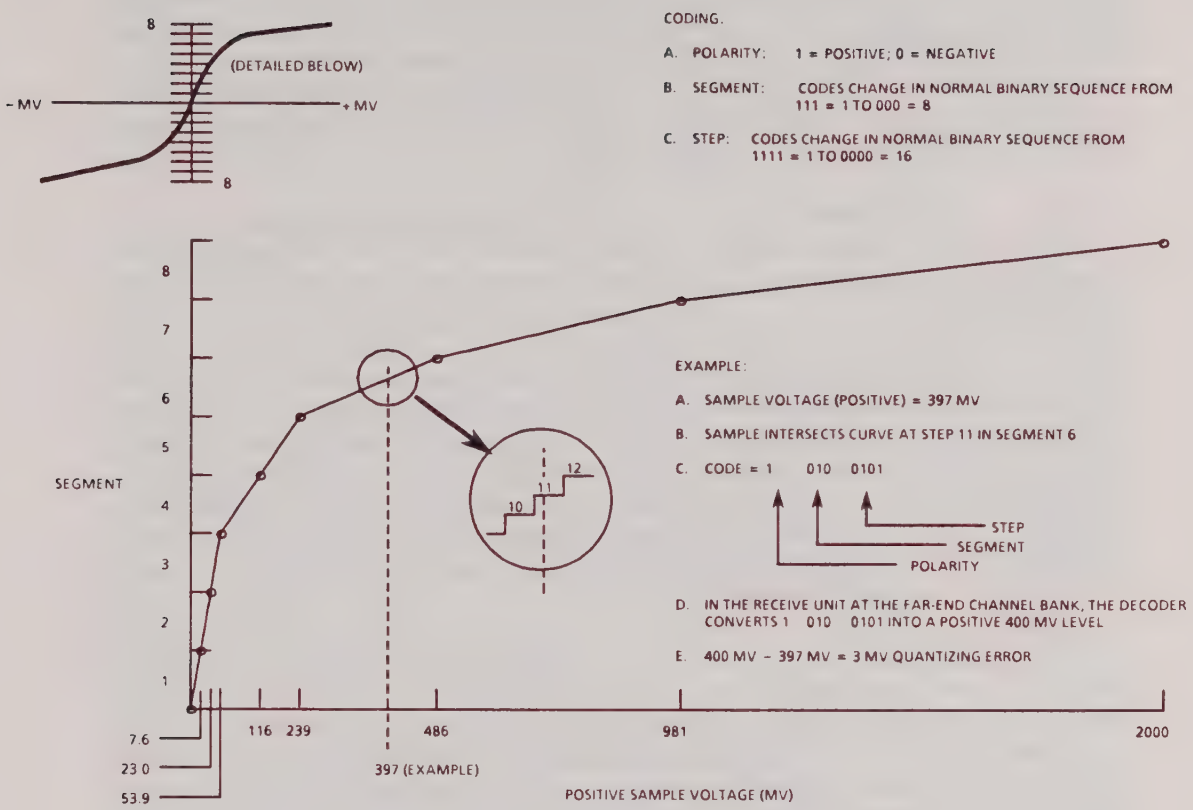


Figure 23. Quantization of Sample Voltages in Channel Unit Codec.

4.23 The VF transmit signals are sampled at the beginning of each channel time slot and the encoded eight-bit word that represents the sample voltage is output on Dx one frame (125 µs) later. Although the coder has a three-state output, an additional three-state buffer is used to enhance system noise performance. Until enabled by TSx', the buffer presents a high impedance to the PCMT bus.

4.24 **Receive Timing.** Each receive unit supplies a single clock signal (ClkR') and 24 channel pulse signals, ChPR-1' through ChPR-24', to the digroup. (In Mode 1 only, corresponding timing signals in digroup A and B are synchronized.) Transmit clock frequencies and channel pulse widths described previously are also applicable to the receive counterparts. Because the channel word is not delayed in the receive unit as it is in the transmit unit, ClkR' is blanked during ChPR-1', for example, whereas ClkT' is blanked during ChPT-2'. (The example refers to the D3/D4 sequence.) Figure 24b is the receive timing diagram.

4.25 During a channel unit's assigned time slot, the decoder accepts the eight-bit word from the PCMR' bus. The analog voltage decoded from the eight bits (or seven bits in a signaling frame) is held on the VFr output until the next frame 125 μs later. In signaling frame 6 or 12, the signaling/supervisory status derived from bit 8 is held on the Sig-r output until the next signaling frame 750 μs later.

4.26 **Trunk Make Busy.** Three signals involved in trunk processing during a system alarm condition (TMB1', TMB2', and TP') are bused from the 91420 Alarm Control Unit to all channel units of the associated digroup(s).

4.27 **SF Signaling.** The details of signaling and supervisory circuits are illustrated and described in the Siemens Communication Practices listed in Table 2 for individual channel unit types. Timing signals SigEnBT from the transmit unit and SigEnBR' from the receive unit are bused to the digroup's channel units. These signals, which change state at the beginning of frames 6 and 12, are required by channel units that multiplex two signaling channels on bit 8 of the PCM word, channel A in frame 6 and channel B in frame 12.

4.28 **ESF Signaling.** Timing signals SigEnBT and SigC/DT (transmit), and SigEnBR' and SigC/DR' (receive) from the TREU are bused to the digroup's channel units. These signals, which change state at the beginning of frames 6, 12, 18, and 24, are required by the channel units that multiplex four signaling channels on bit eight of the PCM word, channel A in frame 6, channel B in frame 12, channel C in frame 18, and channel D in frame 24.

4.29 **TEST Connector.** The VF pairs and E&M leads are accessible through the 12-pin TEST receptacle connector on the front of some of the channel units with a 796A Patch Cord. Patching from TEST on a failed VF-type channel unit to TEST on a matching spare channel unit at each end will restore service. The 796A Patch Cord is wired so that the drop of the failed channel is connected to the carrier of the spare channel. Also, the spare drop is connected to the failed carrier.

4.30 For measuring transmission levels and other channel parameters, the TEST connector is patched to a 91442 VF Test Set or a 91443 Test Patch Panel. There, the VF and signaling circuits of the channel can be accessed in both directions, toward the carrier and toward the drop, with conventional test equipment and cords.

4.31 The VF pairs and E&M leads of a channel unit can also be accessed toward the carrier with a 796B Test Cord (VF) or 796C Test Cord (E&M). Table 19 describes the 796-type cords.

4.32 **Telephone-Type Jacks.** Some channel units (Table 17) provide test access through miniature telephone-type jacks instead of a 12-pin TEST connector. The jacks are normal-through toward the carrier and also toward the drop on some units. Four-wire jacks are at standard transmission level points: – 16 TLP transmit and + 7 TLP receive. All units have pin jacks for monitoring directly at the drop interface.

Data Channel Units

4.33 Digital data can be transmitted over 9004B channels at 2.4, 4.8, 9.6, 19.2 and 56 kb/s. Older data channel units have now been replaced with an all rate (switch selectable) data channel unit. The new all rate unit, 91466-01 AR-OCUDP, provides 2.4, 4.8, 9.6, 19.2, and 56 kb/s data service. Its corresponding subscriber unit is the 91467-01 AR-DS0DP. (The abbreviation OCUDP and DS0DP stand for Office Channel Unit Data Port and Digital Signal Zero Data Port). The 91468-01 AR-DSUDP (Data Service Unit Dataport) provides the data rates supplied by the other data units but can also connect the customer's data to the DDS or basic digital service directly rather than via the traditional method of utilizing a standard DSU/CSU to accept data and transmit it to an OCUDP. The older and now discontinued data channel units and their respective rates are as follows:

91460 OCUDP Data Channel Unit (2.4 kb/s)
91461 OCUDP Data Channel Unit (4.8 kb/s)
91462 OCUDP Data Channel Unit (9.6 kb/s)
91464 DS0DP Data Channel Unit (64 kb/s)
91463 OCUDP Data Channel Unit (56 kb/s)
91465 DS0DP Data Channel Unit (64 kb/s)

NOTE: The following information applies to the new data channel units as well as the old data channel units.

4.34 Error correction is provided automatically at all speeds except 56kb/s. If error correction is desired at 56 kb/s, the next sampled time slot in sequence must be preempted.

4.35 Paragraphs that follow give an overview of data channel units (91467 and 91468) and their system applications. For detailed information, refer to Section 342-911-132 for the 91460 through 91465 units and Section 342-911-160 for the all rate 91466 and 91467 data channel units. Section 342-911-161 provides information on the 91468.

4.36 **Low-Speed Data Transmission.** Figure 25 shows applications of DDS and stand-alone (non-DDS) systems. Here, DDS refers to the Digital Data System that is integrated into the nationwide telecommunications system.

FIGURE 24a. TRANSMIT TIMING DIAGRAM

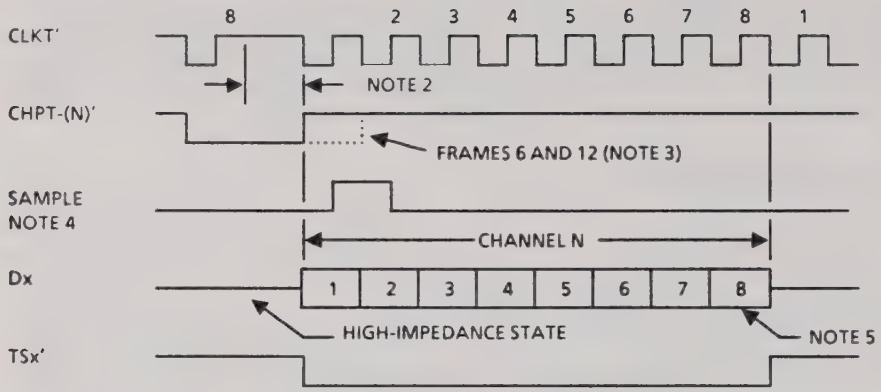
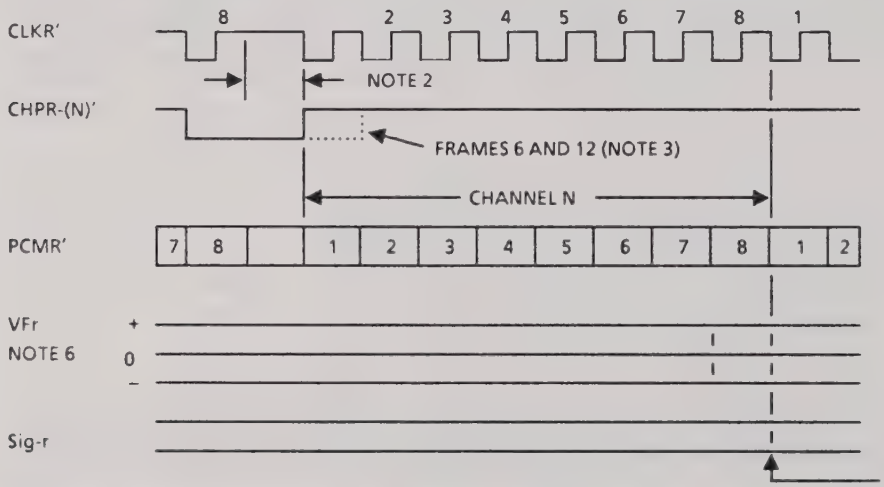


FIGURE 24b. RECEIVE TIMING DIAGRAM



NOTES:

1. Synchronization In end-to-end operation, transmit clock ClkT' and receive clock ClkR' may be synchronous or asynchronous according to the system application.

2. Framing Bits. The transmit and receive clocks have gaps at the framing bit time slots That is, the level remains high for one or two cycles. In mode 1, there are three one-cycle gaps and one two-cycle gap in each frame. In modes 2 and 3, there is one one-cycle gap in each frame.

3. Channel Pulse In nonsignaling frames, the channel pulse width is one clock cycle plus the gaps referred to in Note 2, where applicable. In signaling frames 6 and 12, the channel pulse width is extended one additional clock cycle.

4. Sample Pulse The analog voltage on VFX is sampled in one frame and the encoded value is output on Dx as a seven- or eight-bit PCM word in the next frame 125 µs later.

5. Transmit Signaling In frames 6 and 12, the signaling state is gated directly through the coder as bit 8 of the PCM word: logic 1 on Sig-x produces logic 1 on Dx.

6. VF Receive The analog voltage is decoded from bits 1-8 of the PCM word in nonsignaling frames and bits 1-7 in signaling frames. The voltage is applied to VFr after bit 8 and held for one frame (125µs)

7. Receive Signaling In signaling frames 6 and 12, the logic level of bit 8 in the PCM word is latched in the decoder and held on Sig-r until updated in the next signaling frame

Figure 24. Channel Unit Timing Diagram.

4.37 The OCUDP data channel unit translates the subrate data stream to 64 kb/s and inserts it into one channel time slot of the 1.544-Mb/s digroup transmit signal. The translation process includes these two main steps:

(a) Eight-bit bytes are formed by bracketing each six data bits with 0 as bit 1 and 1 as bit 8. This increases the data subrates by one-third to 3.2, 6.4,12.8, and 19.2kb/s.

(b) Data rate is built out to 64 kb/s by repeating each eight-bit byte 20, 10, and 5 times, respectively, for the three subrates: 3.2 x 20, 6.4 x 10, or 12.8 x 5 = 64 kb/s. This process is called "byte stuffing."

4.38 In the receive direction, each original byte and the four following stuffed bytes go through a majority vote (3 of 5) error correction process. Normally, this process maintains a 10-8 maximum error rate even when the repeatered line error rate is as high as 10-3. The corrected data is output to the subscriber loop at the 2.4, 4.8,9.6, or 19.2-kb/s subrate.

4.39 The 91464 and 91466 DS0DP Data Channel Units transfer the 64-kb/s data signal of one channel between channel banks at a tandem office or into the DDS network at a hub office. The signal format is bipolar, nonreturn-to-zero.

4.40 **High-Speed Data Transmission.** Figures 26a and 26b show applications of DDS and stand-alone (non-DDS) systems similar to the ones shown for low-speed data transmission in Figure 25 but with different OCUDP and DS0DP data channel unit types.

4.41 Figure 26c is a DDS application that allows 56-kb/s data transmission without error correction over one channel. The subscriber loop terminates in an AT&T submultiplexer where data rate is built up to 64 kb/s. The DS0DP channel unit may be either 91465 or 91467 with error correction strapped out. Because "error-free seconds" is a tariffed item, the DS1 or DS1C transmission medium must meet DDS standards, which are higher than the standards for voice transmission.

4.42 The main difference between low-speed and high-speed units is the internal error correction process: low-speed units use byte stuffing and majority vote; high-speed units use Bose-Chaudhuri-Hocquenghem (BCH) codes.

4.43 Error correction is a strapping option on both the 91463 OCUDP and 91465 DS0DP, and a switch option on the 91466 OCUDP and 91467 DS0DP channel units. Data is transmitted via the assigned channel (n). With error correction, BCH codes are transmitted over the adjacent channel (n + 1). "Adjacent" means next in the channel sampling sequence: for example, in the D3/D4 sequence, if n = 24, n + 1 = 1.

Figure 25a. Digital Data System (DDS)

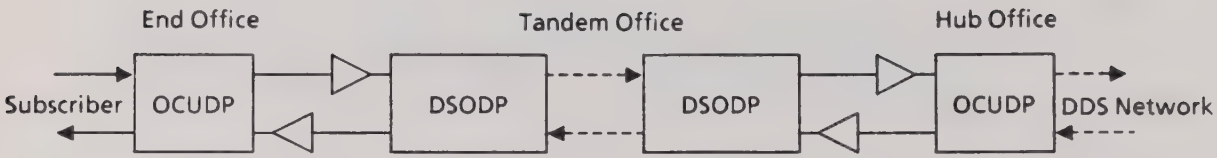


Figure 25b. Stand-Alone System (non-DDS)

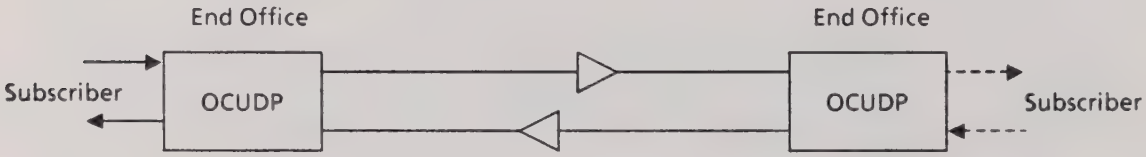


Figure 25c. Stand-Alone System Through a Tandem Office

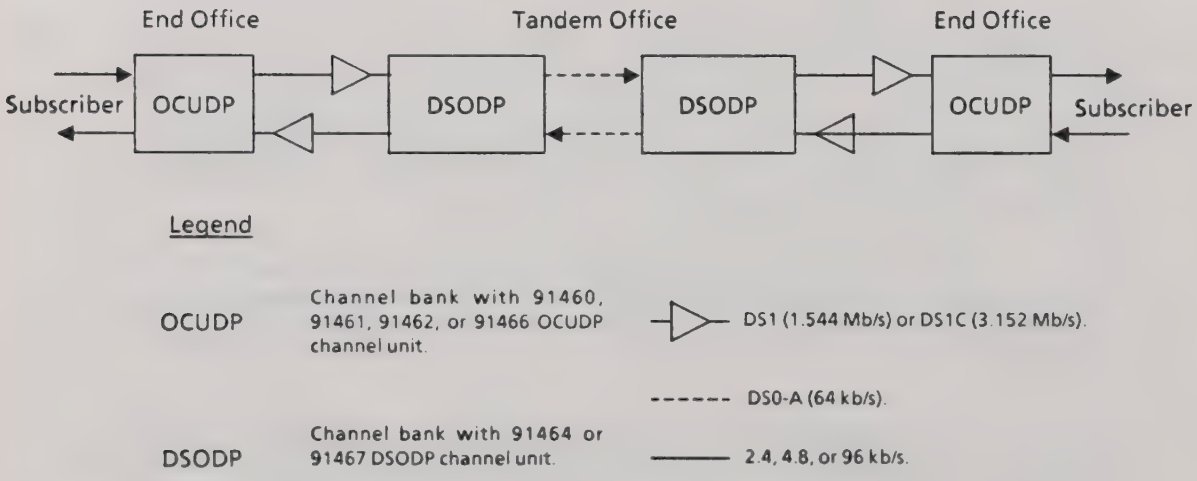


Figure 25. Low-Speed Data Transmission.

Figure 26a. Digital Data System (DDS). [1]

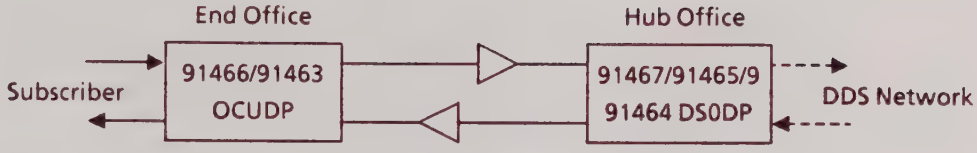


Figure 26b. Stand-Alone System (non- [1]

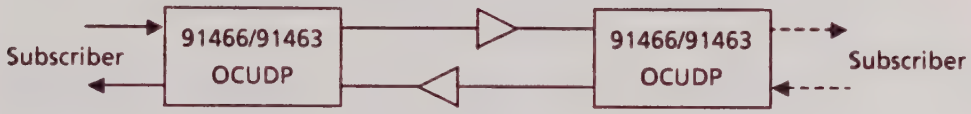
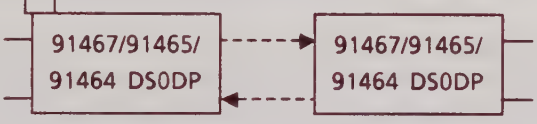


Figure 26c. Digital Data System (DDS) Without Error Correction. [2] [3]

Figure 26d. Tandem Office. [4]



Legend:

OCUDP	Channel bank with 91460, 91461, 91462, or 91466 OCUDP channel unit
DSODP	Channel bank with 91464 , 91465, or 91467 DSODP channel unit.
OCU and ISMX	Office channel unit and integrated submultiplexer (AT&T).

DS1 (1.544 Mb/s) or DS1C (3.152 Mb/s).

DS0-A (64 kb/s).

2.4, 4.8, or 96 kb/s.

NOTES:

[1] In Figures a and b, error correction on the OCUDP and DS0DP channel units is strapped in. Data transmission occupies two adjacent channel time slots.

[2] In Figure c, error correction on the DS0DP channel units is strapped out. Data transmission occupies one channel time slot.

[3] In the DS0DP channel units in Figure c. including tandem offices, may be 91464 instead of 91465.

[4] In Figure d, the DS0DP channel units at the tandem office are strapped for the same error correction option as channel units at the end and hub offices.

Figure 26. High-Speed (56 kb/s) Data Transmission.

4.44 Signal processing in the high-speed data channel units includes these steps:

(a) Subscriber data entering the OCUDP data channel unit at 56 kb/s is built out to 64 kb/s by inserting a bit 8 after each seven data bits. Bit 8 is 1 or 0, respectively, according to whether bits 1-7 represent data or a control code.

(b) The binary number comprising bits 1-8 is divided by a special nine-bit polynomial: 100111001. The eight-bit remainder from the division process is the BCH code, which is transmitted in the adjacent channel immediately after the data byte.

(c) In the receive branch of the unit at the far end, the data byte and its BCH code are assembled into a 16-bit binary number. This number is divided by the nine-bit polynomial 100111001. If the eight-bit remainder from this division process is all 0's, the data is error-free.

(d) The remainder has 256 possible binary values. Each value other than 0000 0000 points to a particular data bit (or bits) as being in error. As an example, a 1110 0100 remainder tells the error corrector to complement data bit 6, which is in error. Any one-bit or two-bit error in a data byte and about one-third of all possible three-bit errors are corrected.

4.45 **Office Interface Unit.** A channel bank with DS0DP channel units must be equipped with a 91419 Remote Performance Interface Unit (RPIU) or a 91448-02 Office Interface Unit (OIU). The RPIU and the -02 option of the 91448 generate the clock and sync signals needed by the DS0DP units.

4.46 In Figure 27, heavy lines show the flow of timing information that synchronizes the channel banks along the route. Beginning at the hub office, the OIU or RPIU obtains a composite clock from the DDS nodal or secondary timing supply. In the OIU or RPIU, the composite clock synchronizes the generation of bit sync and byte sync signals and a 1.544-MHz or 3.152-MHz transmit clock (Ext Clk).

4.47 At the tandem office, the interface unit in the lower channel bank on Figure 27 has a composite clock output rather than an input. The composite clock and the bit sync and byte sync signals from this OIU or RPIU are synchronized with receive channel pulse 24 (ChPR-24'). The OIU in the upper channel bank operates the same as the OIU at the hub office except that the composite clock source is different.

NOTE: The configuration at a tandem office in a non-DDS application is the same as shown in Figure 27 for a DDS application.

4.48 In the opposite direction of transmission, end office to hub office, the DS1 or DS1C signals are synchronized by the looped receive clock option in the transmit units.

Program Channel Units

4.49 **5/8-kHz Bandwidth.** One-way program service with 5-kHz or 8-kHz bandwidth is provided by the following transmit-receive channel unit pair:

91412 5/8 kHz Program Transmit Channel Unit
91413 5/8 kHz Program Receive Channel Unit

Program service, without signaling or control, includes remote-main studio links, secondary studio links, network access links, and studio-transmitter links (a-m broadcasting).

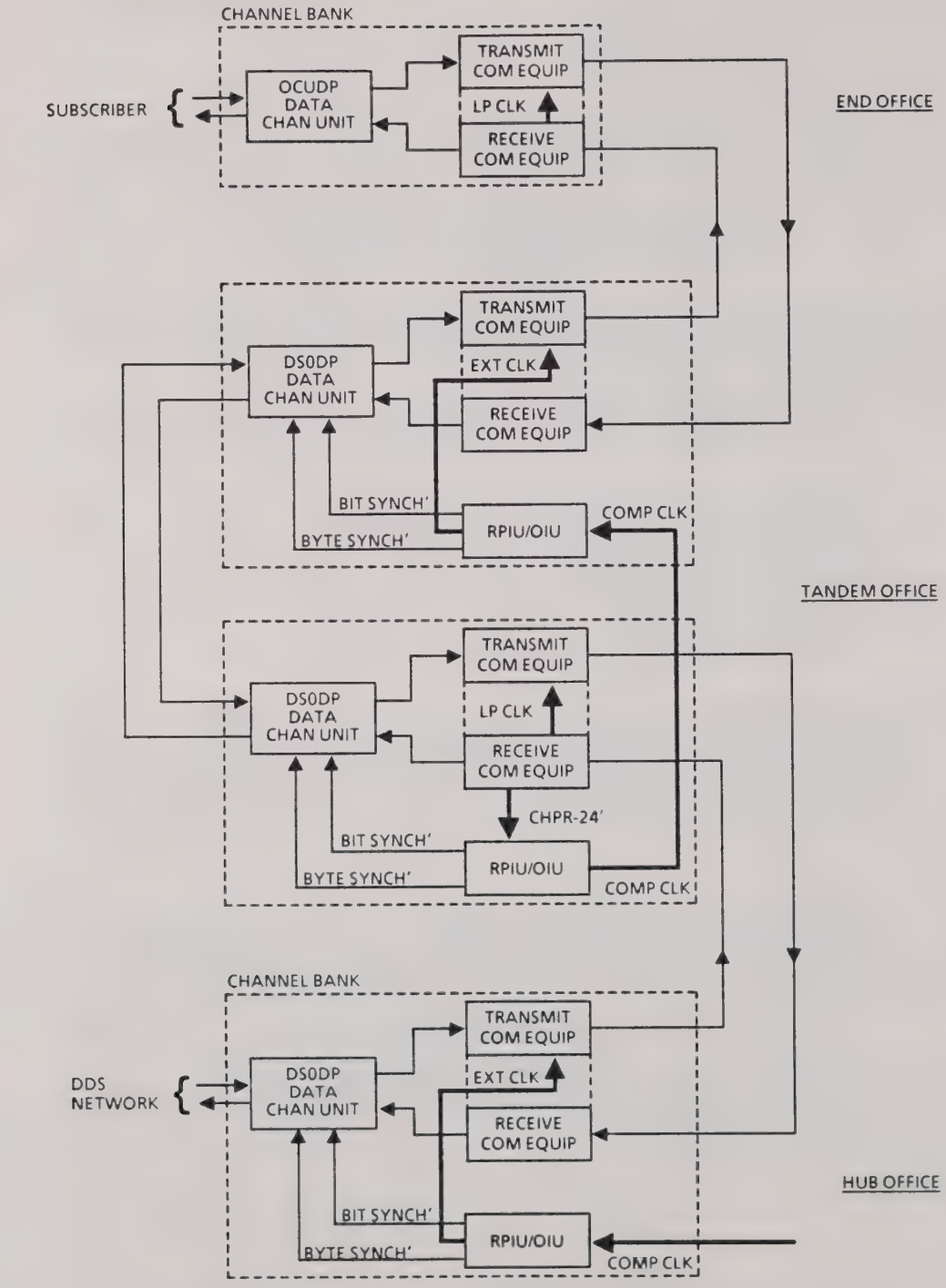
4.50 The 91412 and 91413 program channel units are described in detail in Section 342-911-126. Some features of the units are:

Switch-selectable bandwidth, 5 kHz or 8 kHz
CCITT preemphasis and deemphasis networks
Transmit cable equalizer
Overload indicator
Switch-selectable impedance, 600 or 150 ohms
15-dB attenuators, 1-dB steps

4.51 The extended bandwidth of the program channel units necessitates a higher sampling rate than the 8-kHz rate for channel units that have a nominal 4-kHz bandwidth. The sampling rate is doubled for the 5-kHz option by preempting one additional channel time slot; it is tripled for the 8-kHz option by preempting two additional channel time slots.

4.52 For a program channel unit in slot n, the preempted channels are: n + 12 for the 5-kHz option; n + 8 and n + 16 for the 8-kHz option. As an example, an 8-kHz unit in slot 21 pre-empts channels 5 and 13.

4.53 If the system terminates in 9004 (or AT&T D4) channel banks at each end, any channel may be assigned to program service. If one channel bank is AT&T D3, or equivalent, some channels are not eligible. Refer to Section 342-911-126.



NOTE: In the above diagram, the basic operation is identical whether or not the ESF or Non-ESF common equipment option is being used

Figure 27. Channel Bank Synchronization in a Digital Data System.

4.54 **8/15-kHz Bandwidth.** The following channel unit pair provides one-way program service with a switch-selectable bandwidth of 8 or 15 kHz.

91414 8/15 kHz Program Transmit Channel Unit
91415 8/15 kHz Program Receive Channel Unit

Section 342-911-127 describes the 91414 and 91415 Channel Units in detail.

4.55 For the 8-kHz bandwidth, three additional channel time slots are preempted to achieve a 32-kHz sampling rate. For the 15-kHz bandwidth, five additional channel time slots are preempted to achieve a 48-kHz sampling rate.

4.56 The 8/15 units occupy two mounting slots in the channel bank; the 5/8 units need only one. If the desired bandwidth of a program channel is 8 kHz, the 8/15 unit has an administrative advantage over the 5/8 unit; namely, the four channels occupied by the 8/15 unit are adjacent, whereas the three channels of the 5/8 unit are separated. See Section 342-911-127 for limitations on the assignment of 8/15 channels to program service.

5. COMMON EQUIPMENT

General

5.01 Part 5 describes functional operation and features of the following units that process the digroup signals and digital line signals of the channel bank.

91418 Transmit and Receive ESF Unit (Mode 3)
91438 Transmit Unit
91439 Receive Unit
91427 Line Interface Unit (Mode 1)
91426 Syndes Unit (Mode 2)

5.02 **ESF Common Equipment.** The 91418 Transmit and Receive ESF Unit (TREU) provides either Superframe (SF) or Extended Superframe (ESF) formats, and B8ZS or AMI line code. The TREU is used exclusively in Mode 3 with D3/D4 channel sequencing. Therefore, the TREU replaces the existing 91438 and 91439 units when the 9004B is configured for Mode 3 with D3/D4 channel sequencing. The 91418 TREU, used in conjunction with the optional 91419 RPIU, provides ESF performance monitoring and programming capabilities. Signal characteristics and alarm information requirements are as stated in TR-TSY-000475.

5.03 The TREU is comprised of two PC boards (mother and daughter boards) connected by a ribbon cable, plugged into positions otherwise occupied by 91438 and 91439 units. Refer to Figure 1. Most of the circuitry of this unit is contained on the mother board. The daughter board contains the transmit channel steering/pulse generator circuity and the transmit demultiplexing circuit.

91418 Transmit and Receive ESF Unit

5.04 **General.** The 91418 Transmit and Receive ESF Unit (TREU) is the interface between the 9004 channel units and the DS1 line. The TREU provides bipolar AMI, B8ZS or B7 stuffing, and the standard DS1 interface at 1.544Mb/s. The unit can also be configured for SF or ESF with D3/D4 channel sequencing.

5.05 The ESF capability provides a 4-kb/s data link that is required to pass alarm, signal quality, and configuration information from the TREU to the RPIU.

5.06 The TREU's faceplate contains one slide switch, four LEDs, three sets of strapping pins, and a 20-pin connector. The slide switch inserts a 1kHz digital milliwatt tone. This tone can be manually activated during loopback via this switch and also lights a green LED when the tone is activated. The milliwatt tone is used for testing purposes.

5.07 The three remaining LEDs (red) indicate when the unit has detected Loss of Signal (LOS), Alarm Indication Signal (AIS), and Out of Frame (OOF) conditions.

5.08 Two sets of strapping pins control clocking for the unit. External clock (EXT CLK) selects an external clocking source and is strappable IN or OUT of service via strapping pins. A looped clock (LP CLK) can also be selected and can be placed IN or OUT of service via strapping pins. This clock option selects an internal clocking source.

5.09 The remaining set of strapping pins is labeled B8ZS IN or OUT and chooses between B8ZS and B7 stuffing.

5.10 The 20-pin connector at the bottom of the faceplate provides the interface for the cable that links the TREU to the RPIU.

5.11 **Printed Circuit (PC) Board Strapping.** Strappable options are provided on the PC board for selecting SF or ESF formats, and enabling or disabling received signaling. Refer to Section 342-911-134 for strapping locations and instructions.

5.12 **Line Build Out.** The TREU has a three-position DIP switch that provides Line Build Out (LBO) for cable lengths from 0 to 660 feet from the DSX in the transmit direction. The TREU LBOs eliminate the need to order optional LBOs for the 91430 shelf. Section 342-911-134 provides information and location for settings the LBOs on the TREU Section 342-911-134 also provides instructions to bypass the LBOs on the 91430 shelf.

5.13 **TREU Loopbacks.** The TREU provides the means to initiate various loopbacks utilized for sectionalized testing. Refer to Part 2 and Figure 8 of this Section for information on the loopback capabilities provided by the TREU, and the TREU used with the RPIU.

91418 TREU Functional Operation

5.14 **Option and Channel Sequencing Selection.** The option for SF or ESF is determined by strapping on the TREU board. The faceplate switches control the source of clocking, and the selection of B8ZS or B7 stuffing. Channel sequencing is detected by the TREU via strapping on the 91430 shelf backplane. The above information is fed to the mode/sequence detector and passed onto the framer via the DS1 interface (Figure 28, sheet 1).

5.15 **PCM Signal Input.** The bipolar 1.544-Mb/s DS1 line signal enters the DS1 interface device (Figure 28, Sheet 1). The DS1 interface device converts the signal to dual-rail data and recovers a clock (RCLK) that is phased-locked to the PCM signal frequency. The RCLK signal is split and sent to the T1 framer and to the receive channel steering and pulse generator. If the bipolar signal is absent, the clock oscillator free-runs at 1.544 MHz nominal. The DS1 interface device also provides the following functions:

(a) Transmit LBO equalization.

(b) Loopback circuitry.

(c) Input jitter tolerance/jitter transfer reduction.

(d) Alarm detection - LOS, AIS and OOF.

5.16 **T1 Framer.** The signal passes to the T1 framer. The T1 framer contains both transmit and receive circuitry for frame synchronization, channel timing, signaling extraction, and alarm detection/processing. The framer also provides for D3/D4 channel sequencing, and inserts a 1kHz digital milliwatt tone or idle muted code used for testing during loopback.

5.17 The framer synchronizes on the receive data and puts out PCM data (RSER) and timing information. The main portion of the signal consists of VF information bits 1-7/8 in frames 1 through 12 and signaling bit 8 in frames 6 and 12. The other inputs are from the digital tone generator and signaling freezing circuit. All signals are for 24 channels.

NOTE: VF bits 1 7/8 means bits 1-7 frames 6 and 12 and bits 1-8 in all other frames.

5.18 **PCM Output Signal Select.** The PCM output signal is determined by the status of the four control lines: frame search, AC3 (remote alarm), AC6 (system alarm), and Tn Enbl'. AC3 and AC6 come from the 91420 ACU, and frame search and Tn Enbl' are created internally.

5.19 When the signal is normal (refer to line 1 of Table 7), the signal passes through the selector and is fed to a buffer where it is passed to the channel units via the backplane.

5.20 Lines 2 and 3 of Table 7 show the effect of loss of frame synchronization. The unit goes into frame search, forcing VF bits 1-7 in all frames to VF mute. Signaling bit information is obtained from signaling storage (freezing) circuit. If reframing does not take place in 2.5 seconds, a system alarm (AC6) is activated. Bit 8 now goes idle in all frames and VF bits remain muted as long as the OOF condition exists.

5.21 Line 4 of Table 7 shows the effect of a remote alarm. The VF bits 1-7/8 are forced to logic VF mute and signaling bit 8s are forced to idle.

5.22 **Signaling Freezing**. The signaling freezing circuit mentioned above stores 16 frames of A/B/A/B (SF) or A/B/C/D (ESF) signaling information. During frame search, the signaling information sent to the channel unit is taken 16 frames prior to the activation of channel search. Signaling RAM is organized in blocks of 24 bits (for 24 channels) for each frame. The first block is for A signaling, the second for B signaling, the next for C and the next for D, etc. This signaling information is continually stored for 16 frames.

5.23 Line 5 of Table 7 shows the state of the TREU during a LOLB. The system alarm (AC6') is activated but there is no local or remote alarm. In the case, the VF bits 1-7/8 of the received PCM signal are passed through the selector but signaling bit 8s are forced to idle.

5.24 With the channel bank in LOLB status, setting the TONE switch to ON lights the green LED and produces the condition shown on line 6 of Table 7. Digital tone is inserted as VF bits 1-7/8 in all 24 channels and signaling bit 8s are forced to idle.

5.25 **Digital Tone Generator.** The digital tone is generated by the T1 framer and the output is a repetitive eight-frame sequence of channel words that are decoded by each of the channel units in the digroup as a 1-kHz analog tone at 0 dBm0.

5.26 **Receive Channel Steering and Pulse Generator.** The channel steering circuit provisions the timing information from the T1 framer to provide the timing signals for the channel pulse generator. The channel pulses are extended to every signaling frame for the VF channel units to extract the bit 8 signaling bit.

5.27 Additional width is provided where necessary to accommodate framing bits. This applies to the first channel pulse of the frame because of the S-bit.

5.28 During frame search, the first channel pulse is stretched because the main counter is stopped after the 193rd bit for up to eight clock cycles. Also during frame search, ChPR' is stretched one clock cycle every frame, not just frames 6 and 12, so that the CODEC processes all bit 8s as signaling bits.

5.29 Another output of this device is SigEnBR which is asserted every signaling frame from signals received from the framing circuit. This output is used internally and the inverted SigEnBR' goes to the channel units where it is used to identify the A and B, or A, B, C, and D signaling frames. During frame search, this process takes place every frame instead of every sixth frame.

5.30 **Receive Channel Pulse Demultiplexer.** Channel pulses are distributed through a demultiplexer to the channel units where they function as CODEC receive sync pulses. The 24 lines to channel units 1 through 24 are designated ChPR-1' through ChPR-24'; suffix A or B is added for digroups A and B, respectively.

5.31 A three-position strapping plug on the shelf sets the logic levels as shown in Figure 13. The shelf should always be strapped for D3/D4 channel sequencing when using the TREU.

5.32 **Receive Clock with Gaps.** The receive clock (CLKR) and the inverted CLKR' synchronize the receive timing signals and the channel unit decoders with the digroup PCM signal. The clock designated CLKR is derived by inhibiting RCLK' from the demultiplexer by inhibiting the 1.544-MHz clock at the 193rd bit.

5.33 **Transmit Channel Steering and Pulse Generator.** This circuit shifts the channel sequencing timing from the T1 framer by 2 1/2 clock cycles. This process generates channel pulses that are compatible with the 9004B system. The transmit channel steering circuit provides the enable pulse at bit 8 of the previous channel for one cycle for non-signaling frames. For signaling frames, the enable pulse is extended to two cycles. These extended channel pulses let the channel units know that they are a signaling frame.

5.34 The channel pulse for channel 1 is three clock cycles during signaling frames due to the 193rd bit (framing bit).

5.35 **Transmit Signaling Frames.** Another output of the transmit channel steering and pulse generator is the SigEnBT and SigC/DT signals which are used by the channel unit to differentiate between A and B (SF), or A, B, C, and D (ESF) signaling bits.

5.36 **Transmit Channel Pulse Demultiplexer.** The five -bit counter is decoded in to 24 channel pulses which are distributed to each channel unit. This pulse gives each channel its time slot during which to write PCM data on to the PCMT bus. The 24 lines to channel units 1 through 24 are designated ChPT-1' through ChPT-24'; suffix A or B is added for the digroup.

5.37 **Transmit Gapped Clock.** The clock that controls the shift register (CLKT) has gaps in the time slots assigned to the framing bits. The 1.544-MHz clock has a gap at the S-bit of each frame. This output clock is inserted after the signal passes through the transmit portion of the T1 framer.

5.38 **Transmit T1 Framer.** Operation of the transmit portion of the T1 framer is just the opposite of the receive portion of the T1 framer. The output of the framer is dual-rail data and TCLK which is fed to the DS1 interface circuit.

5.39 **Transmit Clock/Loopback Select.** This circuit (part of the DS1 interface circuit) controls which clock (external, internal or looped) is to be used and establishes the various loopbacks that can be requested.

5.40 **Transmit Clock.** Via the switches on the faceplate or from a CRT terminal via the RPIU, either an external clock (EXT CLK), internal clock (INT CLK), or looped clock can be selected as the TCLK signal to be used by the unit. If an external clock is selected, it can come from any source but generally will come from the 91448-02 or the 91419-02 unit. If internal clock is selected, the clock is generated from the DS1 interface circuit. If looped clock is selected, the clock from the received DS1 signal (RCLK) is looped back via the DS1 interface to the output of the DS1 interface as TCLK and fed to the transmit side of the T1 framer. There is no priority for clock allocation to allow for flexibility during the different loopbacks.

5.41 **Loopback Select.** The DS1 interface device receives loopback requests from the 91420 ACU (manual) or from a CRT terminal via the RPIU for Local Loopback (LOLB). The DS1 interface receives Local Path Loopback (LPLB), and requests for both near and far Remote Loopback (RMLB) or Payload Loopback (PLLB) from a CRT via the RPIU. The 91420 ACU must be in alarm for any of the loopbacks to be activated. The various loopbacks are described in Part 2 and shown in Figure 8 of this Section.

5.42 The 91420 ACU sends the manual request for LOLB via a pushbutton on the faceplate (LOOP). The manual LOLB signal (AC5') or the request via the RPIU (LOLB') is received by the TREU and processed by the loopback select circuit. Refer to Figure 8. During LOLB, the digital transmit signal is looped to the receive branch and an all 1s signal is sent to the line. In addition, the receive side channel pulses are shifted such that channel 1 and 13 "talk" to each other.

5.43 Requests for line or payload loopbacks (near and far) are sent by a CRT terminal via the RPIU unit. Remote loopbacks take place within the DS1 interface circuit while payload loopbacks take place outside the T1 framer circuit (refer to Figure 8).

5.44 **Alarm and Error Rate Decoder.** This circuit receives alarm information from the DS1 interface circuit (LOS and AIS), and alarm (OOF) and performance monitoring (BPV, FE, and CRC6) from the T1 framer. DP alarm is also received from the RPIU. The alarm information is used to light the respective alarm LEDs on the faceplate and pass the alarm to the 91420 ACU and 91419 RPIU. This alarm information is reported as a local (yellow) alarm. The RPIU also uses the data received by the error decoder to provide performance monitoring for the quality of the signal.

5.45 LOS is detected after 300 consecutive zeros are received. The first received 1 that is not a Bipolar Violation (BPV) resets the LOS.

5.46 AIS is activated when a string of 2316 ones with no more than two zeros is detected. AIS is deactivated when three or more zeros are detected in a string of 2316 ones after the AIS alarm was activated.

5.47 OOF is declared when two out of five errors are detected in the framing (Ft) pattern.

5.48 A remote alarm is declared on the ACU in the SF mode when a count of bit 2 = 0 is received for 255 consecutive channels. In the ESF mode, an alarm is declared when the count reaches 16 patterns of 8 zeros and 8 ones on the facility data link. Remote alarm is indicated to the 91420 ACU which declares a yellow alarm.

5.49 A BPV is declared when AMI code is violated. The RPIU accumulates raw counts of BPVs and uses this and other information to provide performance monitoring.

5.50 The T1 framer provides information on CRC6 errors. A CRC error occurs when the calculated CRC-6 code does not match the CRC-6 code received over the FDL. CRC-6 counts are also used by the RPIU to provide performance monitoring information. CRC-6 errors apply only to ESF format.

5.51 Framing Errors (FE) is declared when only 1 of the received framing bits (Ft) is in error. The error detector extends each FE pulse to simulate 10E-3 error rate and a Ft comparison takes place every 250 mseconds and sends a pulse to AC1. In the ACU, AC1 is sampled every 5 mseconds and the samples are integrated in software. If the count reaches 24, corresponding to continually OOF for 60 mseconds, a local alarm on the ACU is declared. This alarm is also ORed to the RPIU.

5.52 **RPIU Interface Circuitry.** Circuity is located on the TREU which decodes information from the RPIU. This information is fed into the read and write registers contained on the TREU. The write registers include the control and clear functions, and the read registers include the control read back, configuration, alarm, and BPV functions. There are also storage registers for the information received from the RPIU.

5.53 The physical interface is two 20-pin ribbon cables. One end of each cable plugs into the faceplate of each TREU and the other end plugs in to the RPIU faceplate.

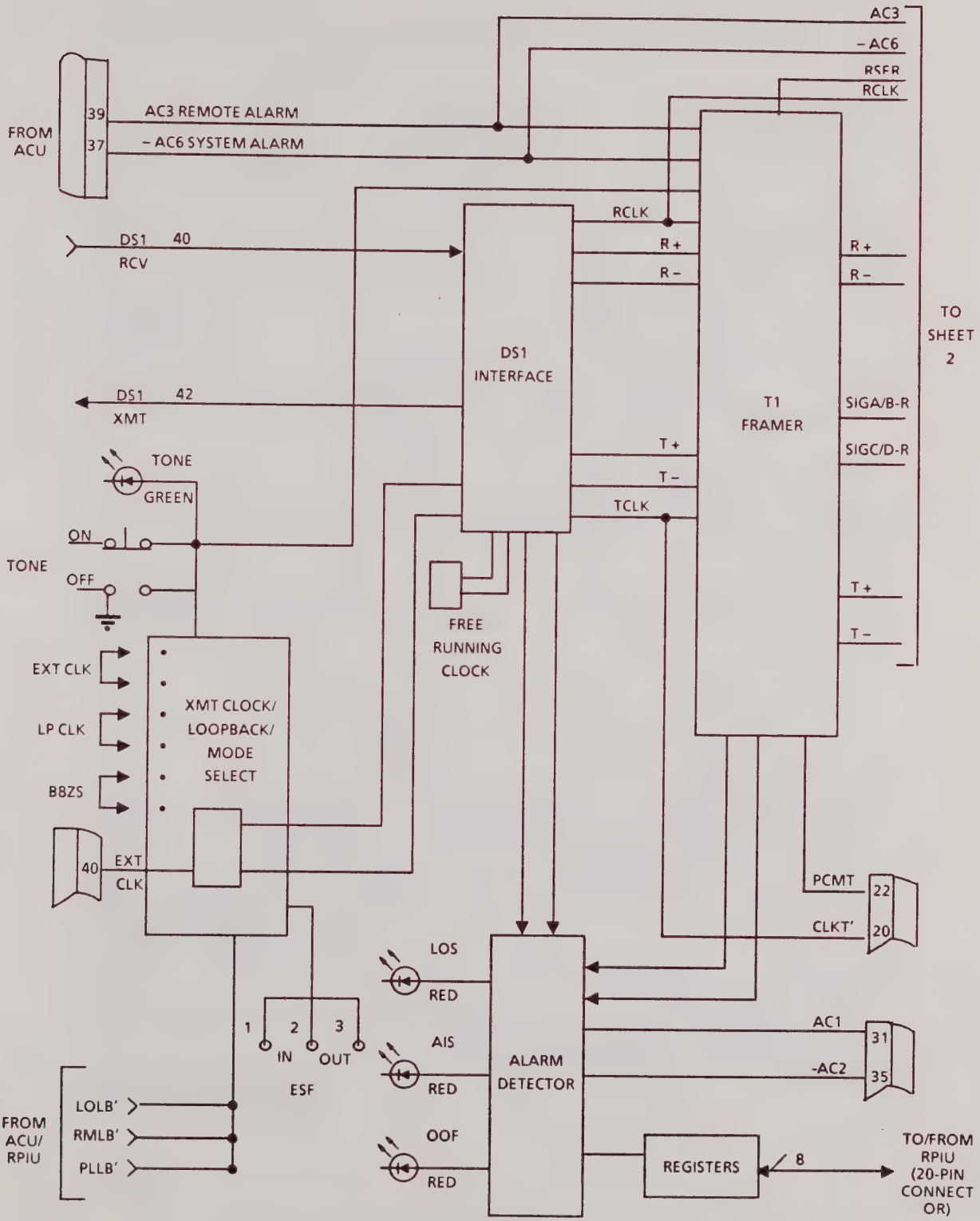


Figure 28. 91418 Transmit and Receive ESF Unit - Circuit Diagram (Sheet 1 of 2).

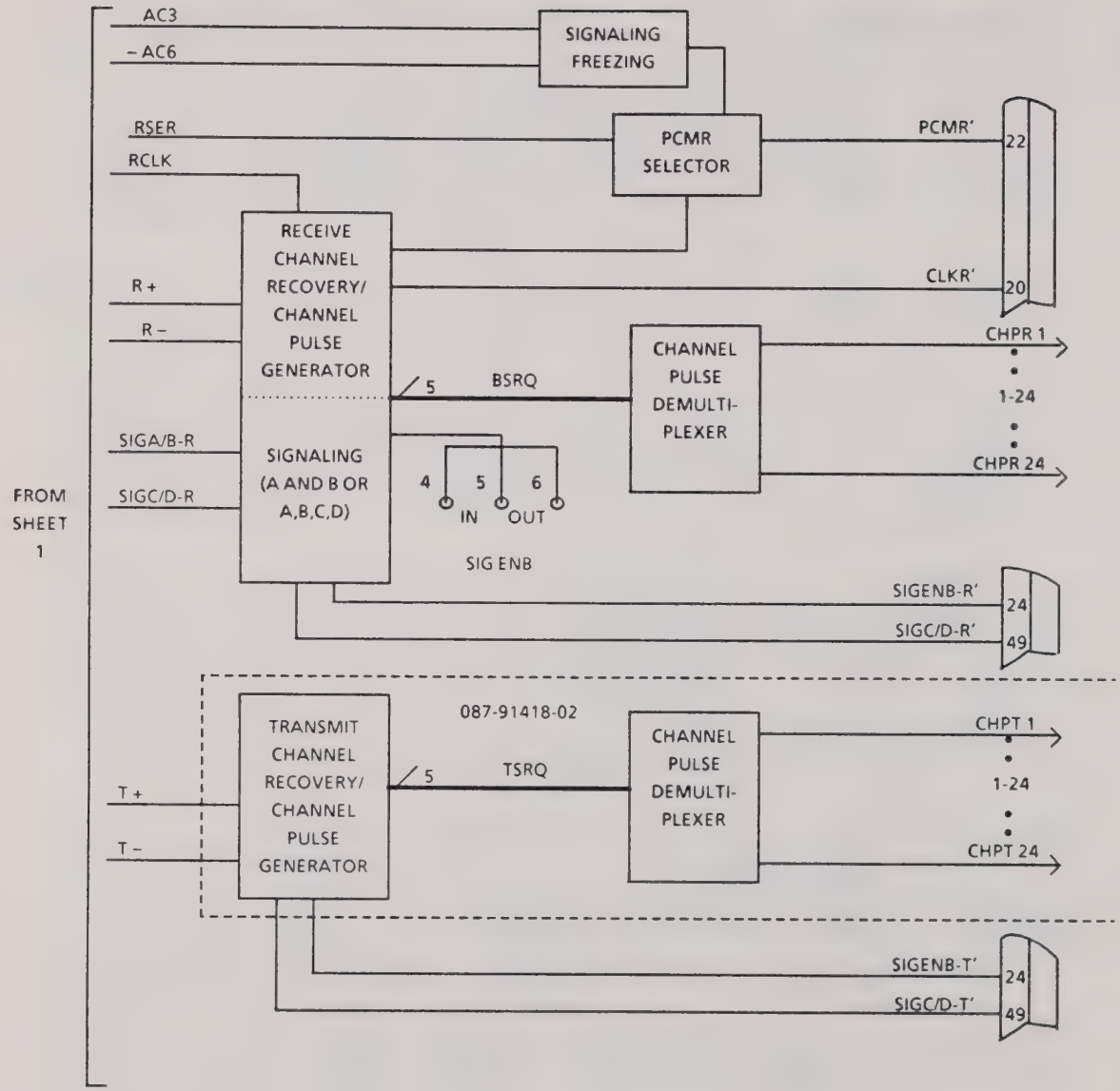


Figure 28. 91418 Transmit and Receive ESF Unit - Circuit Diagram (Sheet 2 of 2).

Table 7. Output Under Normal, Alarm, and Test Conditions.

Line	Status of Control Inputs (Blank = Normal)				PCM Signal Output (*)
	Fr Sch	AC 3 (Rem Alm)	AC 6' (Sys Alm)	Tn Enbl'	
1					VF bits 1-7/8 and sig 8 same as received pcm.
2	Search				VF bits 1-7 muted; bit 8 from sig bit storage.
3	Search		Alarm		VF bits 1-7 muted; bit 8 idle.
4		Alarm	Alarm		VF bits 1-7/8 muted; sig bit 8 idle.
5			Alarm		VF bits 1-7/8 same as received PCM; sig bit 8 idle.
6			Alarm	On	VF bits 1-7/8digitasl tone; sig bit 8 idle

* VF bits 1 7/8 means bits 1 - 7 frames 6 and 12 and bits 1 - 8 in all other frames. Sig bit 8 means bit 8 in frames 6 and 12

91438 Transmit Unit

5.54 **Mode Selection.** The unit plugged into 91430 receptacle connector J72 determines whether the 91438 unit will be configured for Modes 1 or 2. Respectively, the M1 Sel' and M2 Sel' lines (left side of Figure 29) are grounded by a line interface unit and a syndes unit plugged into J72. If J72 is unoccupied, M3 Sel at the gate 8 output is logic 1 and the transmit unit operates in Mode 3.

5.55 **PCM Signal Input.** Eight-bit channel words from the PCM bus of the digroup are clocked into a shift register in the zero code detector shown in Figure 29. As each bit enters, the corresponding bit of the previous word exits. If the shift register is loaded with all zeros at D8 time, bit 7 is forced to binary one to maintain the minimum pulse density required by the system.

5.56 Also at D8 time, if AC4 from the alarm control unit is high, bit 2 of each channel word is forced to binary zero as an alarm indication to the far terminal.

5.57 The clock that controls the shift register (ClkT) has gaps in the time slots assigned to the framing bits. The 1.544-MHz clock in Modes 2 and 3 has a gap at the beginning of each frame for S-bit insertion. In Mode 1, the clock is 1.576 MHz with a gap for S-bit insertion in the transmit unit and other gaps for insertion of F-bits downstream in the line interface unit.

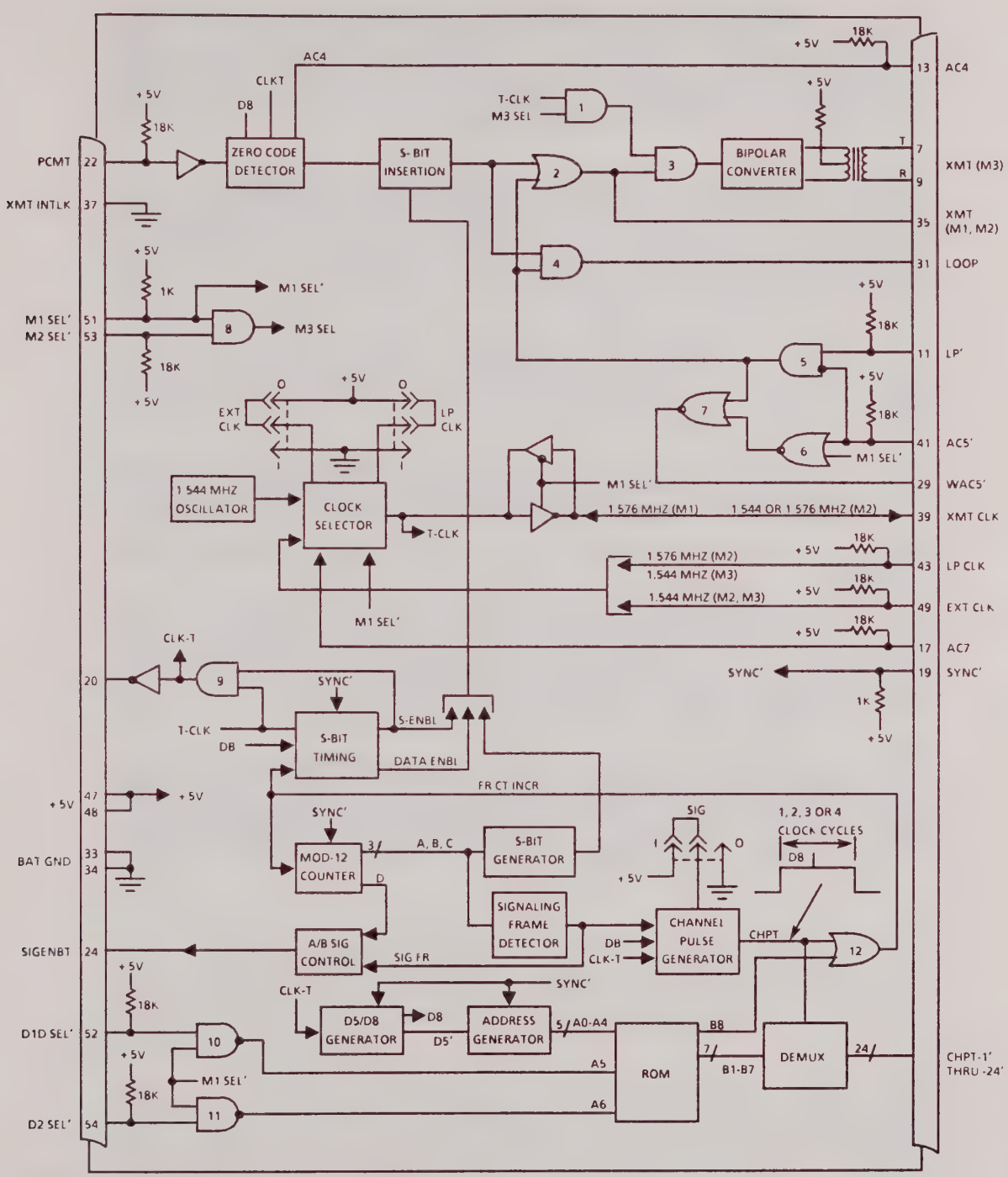
5.58 **PCM Signal Output.** After S-bit insertion, the PCM signal continues through gate 2 and leaves the transmit unit at pin 35 as a unipolar nrz signal used in Modes 1 and 2. In Mode 3, gate 1 is enabled and TClk clocks the PCM signal through gate 3 as an Return-to-Zero (RZ) signal with 50-percent duty cycle. The bipolar converter routes alternate 1s in the bit stream to the two halves of the center-tapped transformer so that consecutive output pulses have opposite polarity. Pulses are generated during the last half of the clock cycles.

5.59 **Looped Terminal (LT) Status.** During channel bank LT status, AC5' from the alarm control unit is low. This does not affect the PCM signal output in Mode 1 because gate 5 is disabled by a ground on the LP' line within the line interface unit. But in Modes 2 and 3, the gate 5 output goes to logic 1, blocking the unipolar signal at gate 2 and routing it through gate 4 to pin 31 from where it is looped back to the receive unit. Additionally in Mode 3, the steady logic 1 at the gate 2 output is clocked through gate 3 to produce an all 1's DS1 digital line signal.

5.60 To check overall channel bank operation in Mode 2 during LT status, the digroup can be unlooped momentarily by depressing the TEST pushbutton on the syndes unit. The resulting logic 0 pulse on the LP' line from the alarm control unit produces logic 0 at the gate 5 output, restoring the digroup signal to its normal output at pin 35 for 300 milliseconds.

5.61 **Winked AC5' (WAC5').** In Mode 1, gate 5 is disabled by ground on the LP' line and gate 6 is enabled by logic 0 on M1 Sel'. Through gates 6 and 7, the logic state on AC5' appears on the WAC5' line that controls the looping relay in the receive unit.

5.62 In Modes 2 and 3, gate 6 is disabled by logic 1 on M1 Sel'. Now, the logic state on AC5' is repeated on WAC5' via gates 5 and 7. If the LP' line is activated (LT status, Mode 2 only), WAC5' is winked to logic 1, releasing the looping relay for 300 milliseconds.



TRANSMIT TIMING SOURCE (MODE2 OR 3)	STRAPPING PLUG POSITIONS	
	EXT CLK	LP CLK
INTERNAL CLOCK	0	0
EXT CLOCK FROM OIU	1	1 OR 0
LOOPED RECEIVE CLOCK	0	1

CHANNEL STRAPPING VIA BIT 8	SIG STRAPPING PLUG POSITION
YES	1
NO	0

Figure 29. 91438 Transmit Unit - Circuit Diagram.

5.63 **Transmit Timing.** In Mode 1, the transmit unit timing source is a 1.576-MHz clock (with gaps) supplied by the line interface unit on the Xmt Clk line and entering at pin 39. Logic 0 on M1 Sel' blocks the clock selector output and closes a path from pin 39 through the input three-state gate to the internal T-Clk distribution.

5.64 In Modes 2 and 3, the timing source is an internal clock from a 1.544-MHz oscillator, an external clock from the 91448-02 Office Interface Unit at pin 49, or looped receive clock at pin 43. Clock selection is controlled by two strapping plugs designated EXT CLK and LP CLK and by the AC7 line from the alarm control unit.

5.65 In channel bank LT (looped terminal) or LL (looped line) status, or in a local alarm condition, AC7 from the alarm control unit goes to logic 1. If the LP CLK strapping plug is in position I, the clock selector switches to internal clock.

5.66 **Clock Output.**The output of the clock selector goes through a three-state gate to the Xmt Clk line at pin 39 in Modes 2 and 3. Timing in the receive unit is controlled by this clock in a Mode 2 channel bank in LT status. The clock is present at pin 39 in Mode 3 but is not used by the receive unit.

5.67 **S-Bit Timing.** This circuit generates an S-Enbl pulse that is logic 0 during the S-bit time slot and a complementary Data Enbl pulse. Timing is controlled by logically combining Fr Ct Incr, which coincides with the first channel pulse of each frame, and the D8 pulse.

5.68 Through gate 9, S-Enbl inhibits T-Clk to produce a 1.544-MHz or 1.576-MHz clock with gaps at the S-bit time slots. This clock, designated ClkT', controls transmit timing in the channel unit codecs. (In Mode 1, T-Clk is a 1.576-MHz clock supplied by the line interface unit and it already has gaps at the F-bit time slots.)

5.69 **S-Bit Generator.** The leading edge of Fr Ct Incr drives a mod-12 counter with four binary outputs: A, B, C, and D. Three outputs are decoded by the S-bit generator to form and interleave the two S-bit patterns: 101010 in odd-numbered frames 1 through 11 and 001110 in even-numbered frames 2 through 12.

5.70 **Signaling Frames.** Binary outputs A, B, and C of the mod-12 counter are also decoded to produce a Sig Fr pulse that is logic 1 during frames 6 and 12. This pulse and the counter's D output are logically combined to generate SigEnBT, which goes low at the beginning of frame 6 and high at the beginning frame 12. The SigEnBT signal is used by the channel units to differentiate between A and B signaling frames.

5.71 **Channel Pulse Generator.** The channel pulse generator output ChPT goes high at the beginning of the D8 clock cycle in the preceding channel word and returns low at the beginning of the next clock cycle in nonsignaling frames or the second clock cycle in signaling frames 6 and 12. If signaling is not required, the SIG strapping plug inserted in the O (Out) position inhibits the extra clock cycle in frames 6 and 12.

5.72 Gaps in ClkT that provide for the insertion of S framing bits and F framing bits (Mode 1) stretch certain channel pulses an additional one or two cycles. Because of the eight-bit delay in the zero code detector, the stretched channel pulse is for the second channel following the framing bit time slots. For example, in Mode 1, which uses only the D3 sampling sequence, channel pulse 2 is stretched two additional clock cycles to allow for insertion of an S-bit and F- bit ahead of channel 1.

5.73 **Channel Pulse Demultiplexer.** Channel pulses are distributed through a demultiplexer to the channel units where they function as codec transmit sync pulses. The 24 lines to channel units 1 through 24 are designated ChPT-1' through ChPT-24'; suffix A or B is added for the digroup.

5.74 The D5/D8 generator at the lower left in Figure 29 includes a mod-8 counter driven by the falling edge of the ClkT pulses. The counter outputs are gated to form D5' and D8 pulses. D5' goes low after the fifth clock pulse and returns high after the sixth clock pulse. D8 coincides with the eighth clock pulse.

5.75 The address generator is a mod-24 counter that cycles from 00000 through 11101 (23) and resets at 11111 (24). These five outputs are lower-order address bits A0 through A4 to the read-only memory (ROM).

5.76 A three-position strapping plug on the shelf controls the logic levels at pins 52 and 54 as shown in Figure 13. In D3 position, pins 52 and 54 are both open. Pin 52 is grounded in D1D position and pin 54 is grounded in D2 position. Thus, through gates 10 and 11, ROM address bits A5-A6 are binary 00 (D3), 10 (D1D), or 01 (D2). In Mode 1, M1 Sel' is low and A5-A6 are binary 11, which also selects the D3 sequence, but regardless of the strapping plug position.

5.77 Stored in ROM are three sets of 24 six-bit codes (B1 through B6). With A5 and A6 selecting the set for D3, D1D, or D2 channel sampling sequence (Table 7), the codes are output in succession under control of A0 through A4 from the address generator. In the demultiplexer, each code causes channel pulse ChPT to appear inverted on one of the 24 output lines, ChPT-1' through ChPT-24'.

5.78 Bit B8 stored in ROM is binary 1 for the first channel in the sampling sequence and binary 0 for all others. Consequently, the Fr Ct Incr pulse from gate 12 is logic 0 only during the first channel pulse of each frame. This is channel 1 in the D1D or D3 sequence, but channel 12 in the D2 sequence.

5.79 **Sync' Pulse.** Timing to establish the time slot locations in the Mode 1 digital signal format originates in the line interface unit. To synchronize the transmit units with the format, the line interface unit supplies a Sync' pulse once each frame during the first clock cycle of the channel 24 PCM word.

5.80 Various counters in the transmit unit timing circuits are initialized by the Sync' pulse. Thereafter, Sync' pulses coincide with reset pulses generated within the counters.

91439 Receive Unit

5.81 **Mode Selection.** The receive unit is configured for Mode 1, 2, or 3 by the unit plugged into shelf receptacle connector J72. With J72 occupied by a 91427 Line Interface Unit or a 91426 Syndes Unit, respectively, the M1 Sel' or M2 Sel' line is grounded. If J72 is unoccupied, M3 Sel' from gate 1 shown at the upper left on sheet 1 of Figure 30 is logic 1.

5.82 **PCM Signal Input, Mode 3.** At the right of Figure 30, sheet 1, the bipolar 1.544-Mb/s DS1 line signal goes through a transformer that provides isolation and a balanced receive line termination. The Mode 3 input circuit converts the bipolar signal to unipolar Nonreturn-to-Zero (NRZ) format and recovers a clock that is phase-locked to the PCM signal frequency. If the bipolar signal is absent, the clock oscillator free-runs at 1.544 MHz nominal.

5.83 In channel bank LT status, WAC5 goes high, operating relay K1 to switch the Mode 3 input circuit to the looped all 1's bipolar signal on the DS1 transmit line at pins 28/30. Entering at pin 36, a looped unipolar PCM signal from the transmit unit is routed through a circuit that verifies operation of the Mode 3 input circuit. Unless the Mode 3 input circuit is producing an all 1s PCM signal and a 1.544-MHz clock, the verification circuit blocks the looped unipolar signal.

5.84 **PCM and Clock Selector.** The selector has two sections, each with four input ports designated C0 through C3. The outputs are determined by the logic states on the A and B select lines as shown in the function table on Figure 30. Select A is logic 0 during LT status; select B is logic 0 in Mode 3.

5.85 The selector outputs in Modes 1, 2, and 3 are as follows.

(a) Mode 1. Outputs are from C3 input ports: 3.152-Mb/s PCM signal (pin 41) and 3.152-MHz clock (pin 43), both from the line interface unit. LT status does not affect the receive unit in Mode 1.

(b) Mode 2. Outputs are from C3 input ports: 1.544-Mb/s PCM signal (pin 41) and 1.576-MHz clock (pin 43), both from the syndes unit.

(c) Mode 2. LT status. Outputs are from C2 input ports: 1.544-Mb/s PCM signal (pin 36) and 1.544-MHz clock (pin 38), both from the transmit unit.

(d) Mode 3. Outputs are from C1 input ports: DS1 signal from the receive line (pins 40/42) and a 1.544-MHz clock recovered from the DS1 signal.

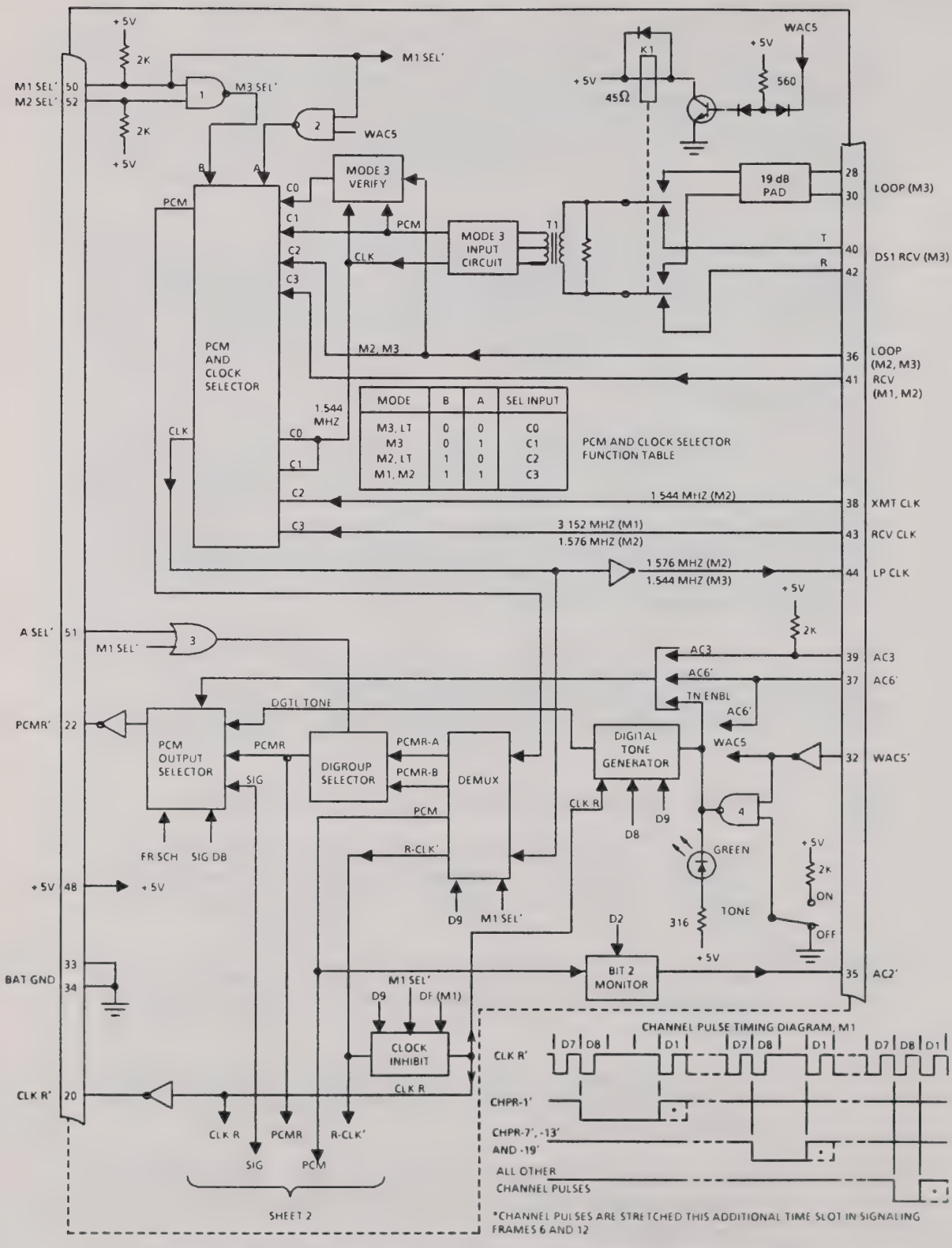


Figure 30. 91439 Receive Unit - Circuit Diagram (Sheet 1 of 2).

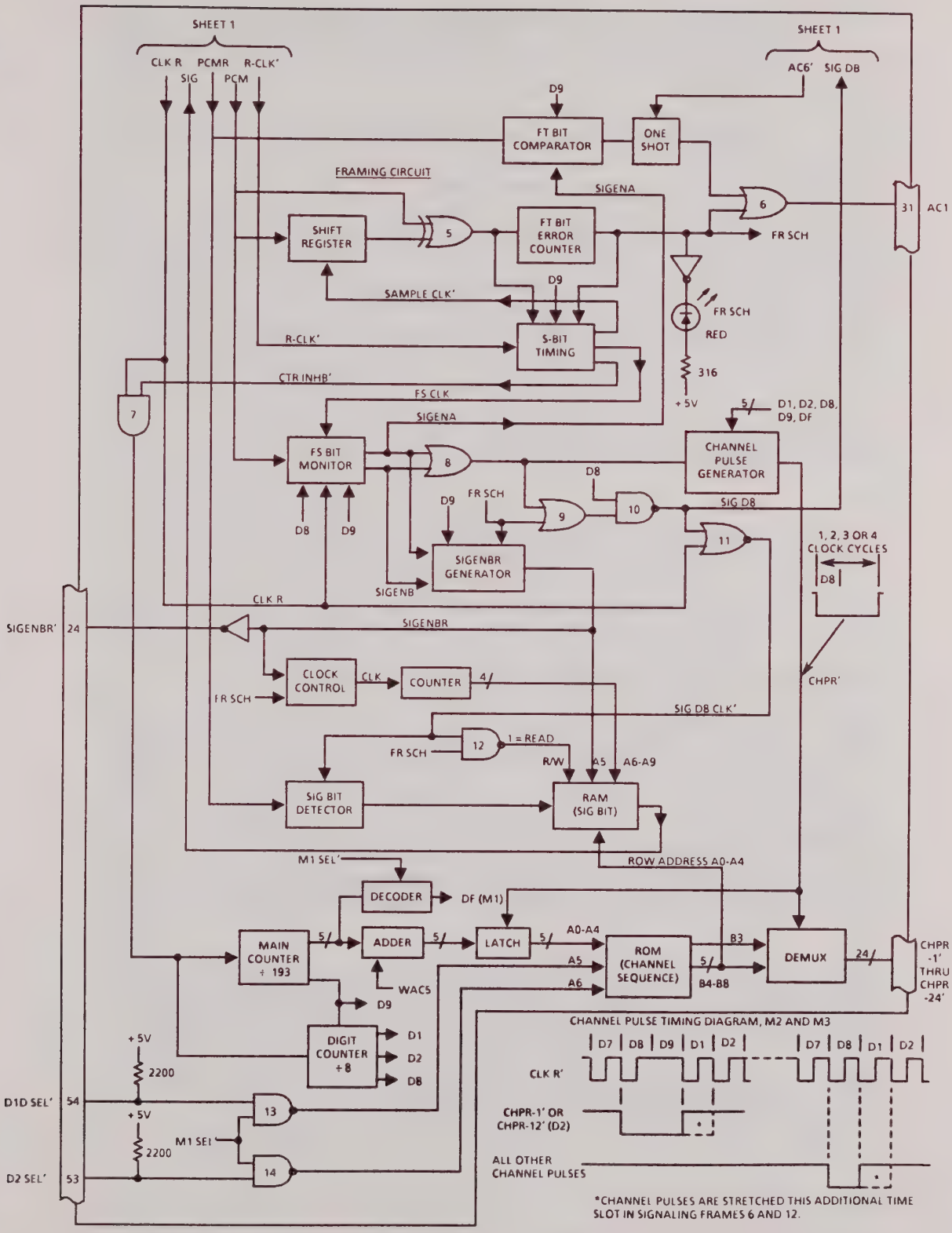


Figure 30. 91439 Receive Unit - Circuit Diagram (Sheet 2 of 2).

(e) Mode 3, LT status. Outputs are from C0 input ports: 1.544-Mb/s PCM signal (pin 36) from the transmit unit and a 1.544-MHz clock recovered from the all 1s transmit line signal (pins 28/30).

5.86 **Looped Receive Clock.** The selected clock in Modes 2 and 3 is inverted and goes over the Lp Clk line to the transmit unit where it is available for the looped receive clock option.

5.87 **Demultiplexer, Mode 1.** Logic 0 on M1 Sel' configures the demultiplexer for Mode 1 operation. From the 3.152-MHz input clock, a clock generator produces complementary clocks that demultiplex the PCM signal into two 1.576-Mb/s bit streams. After the framing circuit has locked onto the digroup B, a phase comparator looks at both digroups during the S-bit time slots (D9 pulse). If the A and B digroups are transposed at the demultiplexer output, the phase comparator will compare digroup B framing bits with digroup A data bits. The phase comparator produces feedback to the clock generator to align the A and B clocks with the A and B time slots in the 3.152-Mb/s input signal.

5.88 Both A and B signals are retimed by the 1.576-MHz B clock and leave on PCMR-A and -B. The B signal and clock are output to the framing circuits (Figure 30, sheet 2) on the PCM and R-Clk' lines.

5.89 **Demultiplexer, Modes 2 and 3.** With logic 1 on M1 Sel', the input PCM signal and clock go directly through the demultiplexer to PCM and R-Clk'. Whether the receive unit is processing digroup A or B, the PCM signal is retimed by the clock and leaves on PCMR-B.

5.90 **Digroup Selector.** The M1 Sel' line is logic 0 in Mode 1 and A Sel' is grounded when the receive unit is plugged into J61, the shelf receptacle connector for digroup A. (Pin 51 of J71, digroup B, is tied to +5V.) With the gate 3 output at logic 0, PCMR-A is connected through the digroup selector to PCMR.

5.91 In all other conditions (Mode 1 digroup B, Mode 2, or Mode 3), the gate 3 output is logic 1 and PCMR-B is connected to PCMR.

5.92 **PCM Output Selector.** The main input is the received PCM signal (PCMR) consisting of VF information bits 1-7/8 in frames 1 through 12 and signaling bit 8 in frames 6 and 12. The other two inputs are digital tone and stored signaling bit 8's (Sig). All signals are for 24 channels.

NOTE: The expression "bits 1-7/8" means bits 1-7 in frames 6 and 12 and bits 1-8 in the other frames.

5.93 The PCM output signal is determined by the status of four control lines: Fr Sch (frame search), AC3 (remote alarm), AC6' (system alarm), and Tn Enbl'. AC3 and AC6' are from the alarm control unit; Fr Sch and Tn Enbl' are created within the receive unit. As indicated on line 1 of Table 7, with all control lines normal, the received PCM signal goes directly through the selector to the output. The format is NRZ.

5.94 Lines 2 and 3 of Table 7 show the effects of loss of frame synchronization. First, Fr Sch goes to the search state, forcing VF bits 1-7 in all frames to logic 0 (VF mute). Signaling bit 8's are obtained from storage and inserted in all frames, not just frames 6 and 12. That is, stored bit 8 of frame 6 is also inserted in frames 7-11 and stored bit 8 of frame 12 is also inserted in frames 1-5. If reframing is not completed within 2.5 seconds, a system alarm takes place and AC6' goes logic 0. Bit 8 in all frames is forced to logic 0 (idle); VF bits remain muted as long as the out-of-frame condition persists.

5.95 Line 4 of Table 7 shows the remote alarm condition: AC3 is logic 1 and AC6' is logic 0. The VF bits 1-7/8 are forced to logic 0 (VF mute) and signaling bit 8's are forced to logic 0 (idle).

5.96 Line 5 of Table 7 shows conditions applicable when the digroup is in looped terminal (LT) or looped line (LL) status. The condition shown is a system alarm (AC6' at logic 0), but no remote alarm or local alarm. The VF bits 1-7/8 of the received PCM signal are passed through the selector but signaling bit 8's are forced to logic 0 (idle).

5.97 With the channel bank in LT status, through gate 4, setting the ON/OFF slide switch on the receive unit to ON lights the green TONE indicator and produces the conditions of line 6 in Table 7. Digital tone is inserted as VF bits 1-7/8 in all 24 channels and signaling bit 8's are forced to idle.

5.98 **Digital Tone Generator.** The digital tone generator is clocked by ClkR and frame-synchronized by D9. The generator output is a repetitive eight-frame sequence of channel words that are decoded by each of the 24 channel units in the digroup as a 1-kHz analog tone at 0 dBm0.

5.99 **Receive Clock with Gaps.** Receive clock ClkR and the inverted ClkR' synchronize the receive unit timing signals and the channel unit decoders with the digroup PCM signal. The clock designated ClkR is derived by inhibiting R- Clk' from the demultiplexer as follows:

(a) Mode 1. The 1.576-MHz clock is inhibited at the S-bit time slot by the D9 pulse and at the four F-bit time slots in each frame by the DF pulses.

(b) Mode 2. The 1.576-MHz clock is inhibited at the S-bit time slot by the D9 pulse. This clock from the syndes unit already has gaps at the control bit time slots.

(c) Mode 3. The 1.544-MHz clock is inhibited at the S-bit time slot by the D9 pulse.

5.100 In each mode, ClkR has 1,536,000 active cycles/second, which provides 8 time slots for 24 channels at the 8-kHz sampling rate (8 x 24 x 8000 = 1,536,000).

5.101 **Bit 2 Monitor.** The bit 2 time slots in the receive PCM signal are sampled by D2 pulses and the AC2' signal is sent to the alarm control unit (Figure 30, sheet 1). In normal operation, AC2' consists of random 5.2-us positive pulses, one for each channel word that has bit 2 in state 1. During a local alarm at the distant channel bank, all bit 2's are transmitted as 0's. In response, AC2' at the near channel bank goes to steady logic 0 to initiate a remote alarm.

NOTE: In Mode 1, AC2-A' and AC2-B' from the two receive units are strapped together. Both units monitor digroup B, but because AC4-A and AC4-B at the distant channel bank are strapped together, both digroups contain the same remote alarm status information.

5.102 **Ft Bit Comparator.** See Sheet 2 of Figure 30. With timing provided by SigEnA and the D9 pulse, successive Ft bits are compared and, if they are the same (an error), a one-shot is triggered and outputs a 28-ms pulse through gate 6 to AC1. In the alarm control unit, AC1 is sampled every 5 ms and the samples are integrated at a + 8/-1 ratio as described in Part 6 under the "Local Alarm" heading.

5.103 Statistically, at a 10-3 error rate in the PCM signal, an error in Ft bit comparison happens every 250 ms and the + 8/-1 integration balances out. At higher error rates, the integration increases in the positive direction until a local alarm is initiated and a system alarm takes place.

5.104 The alarm control unit also integrates AC1 samples at a + 2/-1 ratio. To prevent this second integration from causing an out-and-in cycling of the alarm, the one-shot output pulse is stretched to 110 ms when AC6' is logic 0.

NOTE: In Mode 1, AC1-A and AC1-B from the two receive units are ORed in the line interface unit and the AC1-D goes to the single alarm control unit.

5.105 **Framing Circuit**. As shown in Figure 6, the basic digroup frame consists of an S-bit followed by 192 data bits (8 bits x 24 channels = 192). The S-bit in odd-numbered frames 1 through 11 is the terminal framing bit (Ft) and has a 101010 pattern. The S-bit in even-numbered frames 2

through 12 is the signaling framing bit (Fs) and has a 001110 pattern. The 12-frame period is called a "superframe."

5.106 The function of the framing circuit (Figure 30, sheet 2) is to find the alternating 1/0 pattern of the Ft bits and synchronize the local counters with it. When the receive unit is in-frame, the incoming bit from the Ft time slot and the seven following bits are stored in a shift register. (The time slot locations are based on the local counters.) At the next Ft bit time slot two frames later, the present Ft bit is compared with the stored Ft bit by exclusive-OR gate 5; if they have the same state (0 or 1), an error is tallied. If more than two out of five consecutive comparisons produce errors, the framing circuit goes into the search mode. The Fr Sch lead and the external AC1 lead go to logic 1, and the FR SCH indicator lights.

5.107 In the frame search mode, the eight stored bits are compared with the corresponding bits two frames later, one at a time. The local counters are disabled at gate 7. When a comparison is correct (bits have opposite states), the local counters are enabled and the next comparison is made two frames later. If all eight comparisons are incorrect, the next eight bits are stored in the shift register, the counters are enabled to run ahead two frames, and the process is repeated.

5.108 If 10 consecutive bits at the same location in alternate frames have opposite values, this location is assumed to be the Ft bit time slot and the receive unit is considered "in-frame". The main counter runs without interruption, Fr Sch and AC1 go to logic 0, and the FR SCH indicator goes dark. Once a failed PCM signal has restored to normal, typical reframe time is less than 50 ms.

5.109 **Fs Bit Verification.** Certain types of channel VF signals may contain a 1/0 data bit pattern in alternate frames of the 1.544-Mb/s PCM signal; for example, bit 1 of a 2-kHz tone at any level, or bits 4 and 8 of a 1-kHz tone at 0 dBm0. To prevent the framing circuit from locking onto the data bits, an additional circuit (not shown) is provided to verify the Fs bit pattern. After framing on the supposed Ft bits has been established but before Fr Sch goes normal, the verification circuit searches for the Fs bit pattern. If it is not found in 32 frames, a reframing cycle is forced.

5.110 **S-Bit Timing.** Three timing signals associated with Ft and Fs bit recognition are generated as follows:

(a) Sample Clock. This signal consists of eight clock pulses every other frame. In the frame search mode, according to the Ft bit comparison at gate 5, the signal consists of 8 to 16 clock pulses every other frame.

(b) Counter Inhibit. During frame search, this signal stalls the main counter and digit counter for up to eight clock cycles every other frame.

(c) Fs Clock. This signal enables the Fs bit monitor during even-numbered frames.

5.111 **Fs Bit Monitor.** The Fs bits in the incoming PCM signal are detected and stored for one frame. From the Fs bit pattern, SigEnA and SigEnB, which are logic 1 during the A and B signaling frames, respectively, are developed.

5.112 Additional combinational logic involving gates 8 through 11 produces the Sig D8 and Sig D8 Clk' timing signals. Sig D8 is logic 1 during the bit 8 time slots of signaling frames 6 and 12. Sig D8 Clk' is logic 0 during the last half of Sig D8.

5.113 **SigEnBR Generator.** A D-type flip-flop in this circuit is preset and cleared every sixth frame by SigEnA and SigEnB, respectively. The output SigEnBR is used in the receive unit and the inverted SigEnBR' goes to the channel units where it is used to identify the A and B signaling frames.

5.114 During frame search, the flip-flop is toggled every frame by the D9 pulse so that SigEnBR alternates from logic 1 to 0 every frame instead of every sixth frame. The effect of this is discussed later.

5.115 **Signaling Bit Storage.** Signaling bit 8s from the received PCM signal of the digroup are detected and written into a Random Access Memory (RAM) of one-bit cells arranged in a matrix of 24 rows by 32 columns. Each row is assigned to one channel and each pair of columns stores the 48 signaling bits of one 12-frame superframe. The odd- and even-numbered columns of the pairs are for the A and B signaling bits, frames 6 and 12, respectively.

5.116 RAM cells are addressed in a continuous sequence so that stored data is updated every 16 superframes. In generating RAM addresses, the 16 pairs of columns are selected at A6 through A9 by a four-bit counter driven by SigEnBR. The A and B columns within each pair are selected at A5 by SigEnBR. Channel rows are selected by the five binary outputs of the Read Only Memory (ROM).

5.117 When frame synchronization is lost and Fr Sch goes high, the gate 12 output goes high; writing into RAM is halted and stored data is read out nondestructively to the output signal selector. By action of the counter clock control, for a maximum of six frames, data is read from the pair of columns that was being addressed when Fr Sch went high. The address jumps ahead to the pair of columns that contains data stored 16 superframes previously. The change in SigEnBR during frame search (paragraph 5.112), data is read out of this pair and accepted by the output signal selector in all frames, not just frames 6 and 12. The stored A signaling bits are read out in frames 6 through 11 and the stored B signaling bits are read out in frames 12 and 1 through 5.

5.118 If reframing is completed in less than 2.5 seconds, the PCM output selector immediately goes back to current information. If reframing is not completed in 2.5 seconds, the alarm control unit initiates a system alarm and AC6' goes low. Until the system alarm clears, the PCM output selector forces signaling bit 8s low in all frames.

5.119 **Main and Digit Counters.** The five binary outputs of the main counter are used to address the ROM in a continuous 24-channel sequence. These outputs are also decoded to create a DF signal used in Mode 1 to define the F-bit time slots, which precede bit 1 of channel words 1, 7, 13, and 19.

5.120 The main counter also generates a 648-ns D9 pulse at count 193 to mark the S-bit time slot. The digit counter generates 648-ns pulses at the time slots for bits 1, 2, and 8 of the PCM channel words.

5.121 **Channel Pulse Generator.** The channel pulse generator output ChPR' goes low at the beginning of the D8 clock cycle in the preceding channel word and returns high at the beginning of the next clock cycle in nonsignaling frames or the second clock cycle in signaling frames 6 and 12. The extra width during signaling frames tells the channel unit CODECs to process bit 8 as a signaling bit. Refer to the timing diagrams at the bottom of Figure 30, sheets 1 and 2.

5.122 Additional width is provided where necessary to accommodate framing bits. This applies in all modes to the first channel pulse of the frame S-bit. (Channel 1 is first in the D1D or D3 sequence, but channel 12 is first in the D2 sequence.) It also applies in Mode 1 to the channel pulses for channels 1, 7, 13, and 19 F-bits. (Mode 1 is always D3 sequence.)

5.123 During frame search, the first channel pulse is stretched because the main counter is stopped after the 193rd bit for up to eight clock cycles. Also during frame search, ChPR' is stretched one clock cycle every frame, not just frames 6 and 12, so that the CODEC processes all bit 8s as signaling bits.

5.124 **Channel Pulse Demultiplexer.** Channel pulses are distributed through a demultiplexer to the channel units where they function as CODEC receive sync pulses. The 24 lines to channel units 1 through 24 are designated ChPR-1' through ChPR-24'; suffix A or B is added for digroups A and B, respectively.

5.125 The five binary outputs of the main counter go through an adder stage and a latch to become the lower-order ROM address bits A0 through A4. When the channel bank is in LT status, WAC5 is activated and the five bits are processed in the adder to create an offset between receive and transmit channel pulses. For example, in the D3 sequence, channels 1 and 13 "talk" to each other through the looped digital pulse stream. Signaling is forced on-hook during LT status.

5.126 The five bits are clocked into the latch by the positive-going edge at the end of ChPR' for the preceding channel. This compensates for delay in the ROM and ensures that the demultiplexer downstream will be ready when the next ChPR' begins.

5.127 A three-position strapping plug (customer strapping) on the shelf sets the logic levels at pins 54 and 53 as shown in Figure 13. In D3 position, pins 54 and 53 are both open. Pin 54 is grounded in D1D position and pin 53 is grounded in D2 position. Through gates 13 and 14, ROM address bits A5-A6 are binary 00 (D3), 10 (D1D), or 01 (D2). In Mode 1, M1 Sel' is low and A5-A6 are binary 11, which selects the D3 sequence independent of the strapping plug position.

5.128 Stored in ROM are three sets of 24 six-bit codes (B3 through B8). With A5 and A6 selecting the set for D3, D1D, or D2 channel sampling sequence (Table 3), the codes are output from ROM in succession under control of A0 through A4 from the latch. In the demultiplexer, each code causes channel pulse ChPR' to appear on one of the 24 output lines, ChPR-1' through ChPR-24'.

91427 Line Interface Unit

5.129 **Transmit PCM Signal (Figure 31).** Entering at pins 18 and 24, the digroup A and B PCM signals from the transmit units go through a retiming stage to a combiner. The clock for both stages (ClkT') is 1.576 MHz with gaps at the F-bit time slots, the same as Xmt Clk A and B supplied to the transmit units. In the combiner stage, F-bits are inserted and the digroups are interleaved so that a data bit or framing bit from digroup A is followed immediately by the corresponding bit from digroup B. See Figure 6b for the frame format.

5.130 Digital transmission equipment operates most efficiently when the digital signal has an even distribution of 1s and 0s. The scrambler breaks up long strings of 1s that may appear in a PCM signal, particularly when traffic is light. The scrambler output is the exclusive-OR of the present input bit and the preceding output bit. A 11111111 input becomes a 10101010 output.

5.131 The 3.152-Mb/s signal from the scrambler passes through the transmit loop gate and gate 1 to the bipolar converter. Alternate 1s are routed to the two halves of the center-tapped transformer so that consecutive pulses have opposite polarity. The bipolar signal exits at pins 2/4 on a balanced line through the shelf-mounted equalizer to the external DS1C equipment.

5.132 **Receive PCM Signal.** Entering at pins 40/42 (Figure 31), the DS1C line signal goes through an 8.5-dB pad, relay K1 contacts, and transformer T1 to the input circuit. The pad and transformer provide isolation and a balanced line termination. The input circuit converts the bipolar signal to unipolar NRZ format and recovers a clock that is phase-locked to the PCM signal frequency. If the bipolar signal is absent, the clock oscillator free-runs at 3.152 MHz nominal.

5.133 Continuing through the receive loop gate, the unipolar signal is retimed by the 3.152-MHz recovered clock and descrambled. The clock is also inverted and fed to the receive units on Rcv Clk A and B lines.

5.134 The descrambler restores the PCM signal to the same sequence of 1s and 0s transmitted from the distant terminal. The descrambler output is also the exclusive-OR of the present input bit and the preceding output bit. The NRZ output signal is fed to both receive units, where it is demultiplexed into A and B digroups.

5.135 **Looped Terminal Status.** In channel bank LT status, AC5' from the alarm control unit goes low, operating relay K1 and activating both the transmit loop gate and the receive loop gate. Through the transmit loop gate, the unipolar signal is switched to the loopback path and a steady logic 1 is applied to gate 1. The logic 1 is clocked into the bipolar converter and becomes an all 1s DS1C transmit signal.

5.136 The bipolar signal loops back through a 20-dB pad and relay K1 contacts to the input circuit. As a check of the transmit bipolar converter and the receive input circuit, the bipolar loop verification circuit checks for an all 1's signal and a 3.152-MHz recovered clock. If both are present, the loopback path completes through the verification circuit and the receive loop gate to the main receive signal path.

5.137 **Transmit Timing.** Timing sources for the transmit branch are an internal clock from a 3.152-MHz oscillator, an external clock from the 91448-02 OIU (at pin 41), or the 3.152-MHz clock recovered from the DS1C receive signal. Clock selection is made by two strapping plugs designated EXT CLK and LOOP TIME (shown in the table on Figure 31).

5.138 In channel bank looped terminal (LT) or looped line (LL) status or in a local alarm, AC7 from the alarm control unit goes to logic 1. If the unit is strapped for looped receive clock, the clock selector switches to internal clock.

5.139 A flip-flop divides the 3.152-MHz output of the clock selector to produce opposite-phase 1.576-MHz signals (A Enbl and B Enbl) that interleave digroup A and B transmit signals.

5.140 **Transmit Framing.** As shown in the timing diagram at the bottom of Figure 31, the output of the F-bit timing circuit goes low for one clock-cycle four times in each frame to provide time slots for the F-bits. This circuit, and others, are initialized by a power-on reset pulse (not shown); thereafter, the repetitive sequence of 197 cycles of the 1.576-MHz clock is triggered by the Fr Sync pulse at D1 time of channel 24. The first interval of 17 clock-cycles after the Fr Sync pulse accounts for the following: eight bits of channel 24, the S-bit inserted in the transmit unit, and the eight-bit delay in the transmit unit's zero-code detector. Refer to the transmit unit description and to the frame format in Figure 3b.

5.141 Through gate 4, the output of the F-bit timing circuit creates a 1.576-MHz clock (ClkT) with gaps at the F-bit time slots. Clock pulses blocked at gate 4 go through gate 3 to become the F Enbl signal.

5.142 In addition to the Fr Sync pulses previously described, the F-bit generator produces a 1100 pulse pattern (F1, F1, FO, FO) at the F-bit time slots in each frame.

5.143 Initialized by the power-on reset, the sync generator counts Fr Sync pulses and gates every 12th pulse through to the transmit units via pin 23. The sync pulses frame-synchronize timing in the transmit units and line interface unit.

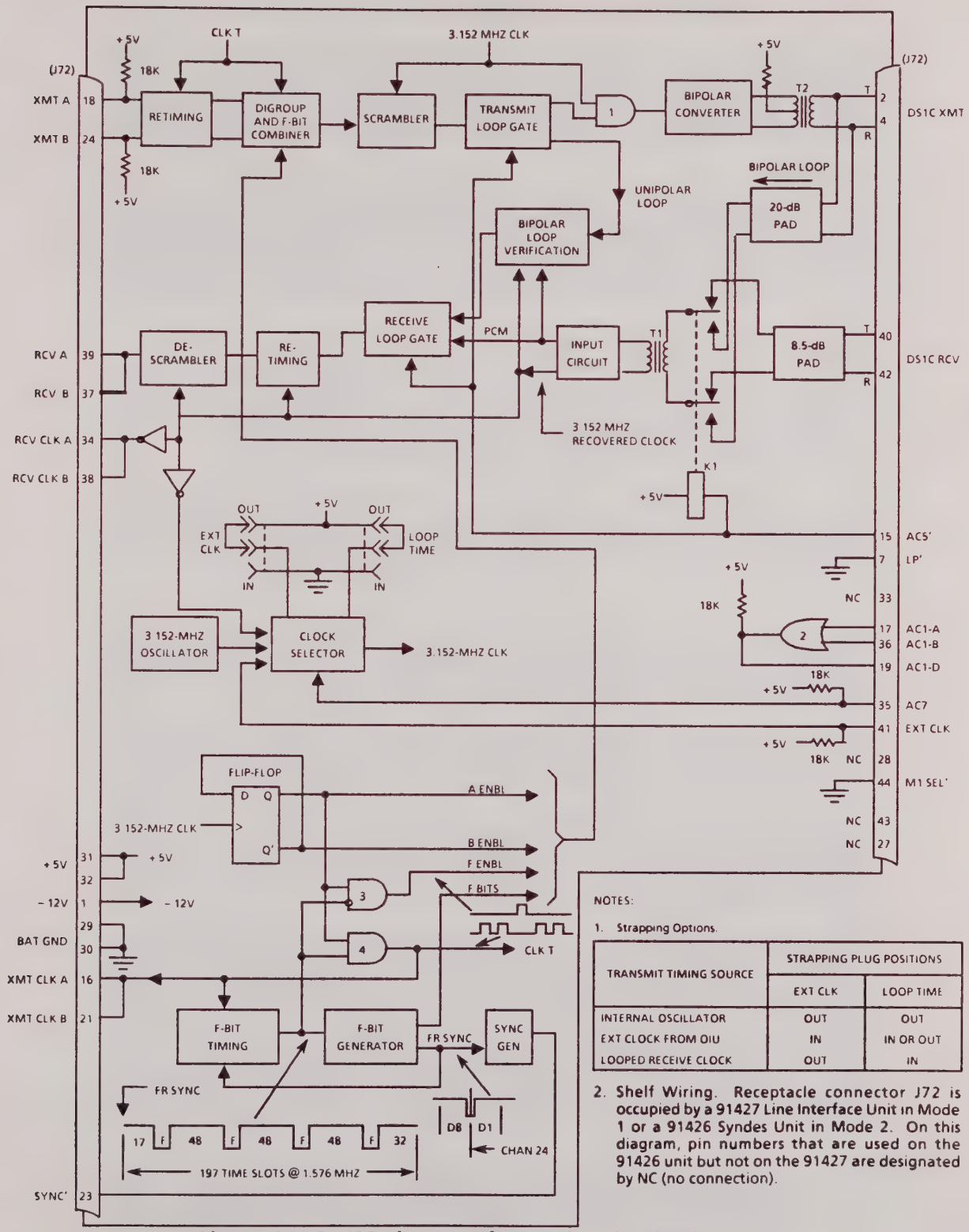
NOTE: F-bits are not presently used for terminal or signaling framing.

5.144 **Mode 1 Operation.** Three circuits shown at the right of Figure 31 and described below are to configure the channel bank for Mode 1 operation.

(a) At pin 7, ground on the LP' line disables the digroup loopback circuit in the transmit units.

(b) Gate 2 combines AC1-A and -B from the receive units into an AC1-D control signal to the single alarm control unit used in Mode 1.

(c) At pin 44, ground on the M1 Sel' line arranges the receive units for Mode 1 operation.



NOTES:

1. Strapping Options.

TRANSMIT TIMING SOURCE	STRAPPING PLUG POSITIONS	
	EXT CLK	LOOP TIME
INTERNAL OSCILLATOR	OUT	OUT
EXT CLOCK FROM OIU	IN	IN OR OUT
LOOPED RECEIVE CLOCK	OUT	IN

2. Shelf Wiring. Receptacle connector J72 is occupied by a 91427 Line Interface Unit in Mode 1 or a 91426 Syndes Unit in Mode 2. On this diagram, pin numbers that are used on the 91426 unit but not on the 91427 are designated by NC (no connection).

Figure 31. 91427 Line Interface Unit - Circuit Diagram.

91426 Model 2 Syndes Unit

5.145 The syndes unit is comprised of two PC boards. The main board contains the receive section, and the alarm and loopback circuits (Figure 32). The transmit section is on the other board, pn 087-57204-01; this board has 12-pin connector P51 that mates with receptacle J1 on the main board.

5.146 In the transmit section, the digroup A and B PCM signals are combined and control bits inserted. The output is a 3.152-Mb/s DS1C digital line signal with M1C-compatible format. The transmit section is shown on sheet 2 of Figure 32 and the description begins in paragraph 5.150.

5.147 The incoming DS1C signal goes through an 8.5-dB pad and contacts of relay K1 to the receive section. The signal is demultiplexed into digroup A and B PCM signals. The receive section is shown on sheet 3 of Figure 32 and the description begins in paragraph 5.164.

5.148 **Alarm Circuits.** If F-bit or M-bit synchronization is lost, the In-Frame lead from the receive section goes low to initiate a local alarm. After 200 ms, the LOCAL indicator lights and control bit M4 of the outgoing DS1C signal is forced to 0 as an alarm indication to the far terminal.

5.149 If control bit M4 of the incoming DS1C signal is 0, the Rem Alm lead from the receive section goes high and, unless gate 1 has been inhibited by a local alarm, the REMOTE indicator lights.

5.150 **Loopback Circuits.** Depressing the TEST pushbutton grounds the LP Req' (loop pulse request) line to the alarm control units. If either or both digroups is in looped terminal (LT) status, a 300-ms pulse is returned on the LP' line from the alarm control units. Relay K1 operates momentarily to open the receive line and bridge the DS1C receive section input to the transmit line through a 20-dB pad. The pulse also unloops the looped digroup(s) momentarily.

5.151 If the syndes unit reframes on the looped DS1C signal, and if both digroups reframe in the receive units, the gate 2 output goes low. (AC1-A and -B from the receive units are low when digroups A and B, respectively, are in-frame.) Reframe time is less than 16 ms in the syndes unit and less than 50 ms in the receive unit. At the end of the 300-ms LP' pulse, the PASS indicator lights if the syndes unit and receive units are in-frame. Otherwise, the FAIL indicator lights. Releasing the TEST pushbutton extinguishes the lighted indicator.

NOTE: If only one digroup is in LT status for this test, the momentary break in the DS1C receive signal will not cause a system alarm in the other digroup, although there will be a 300-ms service interruption.

Syndes Unit Transmit Section

5.152 Entering at pins 10 and 4 of P51, the transmit A and B PCM signals go through identical elastic stores to the digroup combiner (Figure 32, sheet 2). The combined signal is scrambled, control bits are inserted, and the 3.152-Mb/s bipolar signal exits to the DS1C digital line at pins 7/8.

5.153 **Strapping for 9004A/9004B.** The 91426 Model 2 Syndes Unit can be used in a 9004A or 9004B channel bank. For 9004B applications, three strapping plugs on the transmit PC board must be in position B. This enables operation with asynchronous digroup signals from separate transmit units. The functions of the strapping plugs are as follows.

(a) 9004A has one Xmt Clk input and 9004B has two. The strapping plug at the lower left of Figure 32a accommodates this difference.

(b) 9004A has one transmit unit and 9004B has two. The strapping plug at the lower right of Figure 32a allows for one or two Xmt Intlk lines.

(c) The strapping plug at the upper right on Figure 32a sets the nominal peak-to-peak transmit signal level at 4 volts for 9004A or 6 volts for 9004B.

5.154 **Elastic Store.** The elastic store is a timing buffer between the digroup bit stream of the transmit unit and the high-speed DS1C bit stream to the digital line. The elastic store has eight cells with addresses 0 through 7. Data enters under control of the write counter, which generates addresses 0 through 7 in a continuous sequence at 1.544 or 1.576 Mb/s. The read counter also generates addresses, but at 1.576 Mb/s and with gaps that provide a control bit time slot every 53rd clock cycle.

5.155 There is a four-bit delay through the elastic store; for example, data is read out of cell 7 while data is being read into cell 3. If the delay becomes less than four bits, the address comparator activates the two outputs of the stuff control. One output causes the control bit selector to force the C-bits in the next two subframes to 1s as an indication to the far terminal that the subframe contains a stuffed bit. The other output modifies the read sequence so that one cell is read twice; the second reading is in effect a dummy bit that is "stuffed" into the bit stream.

5.156 As shown in Figure 6e, the stuffed bit is in the third time slot of the applicable digroup following the third C-bit (Cc) in the subframe. When stuffing is required, digroup A is stuffed in subframe M1 or M3 and digroup B is stuffed in subframe M2 or M4.

5.157 One multiframe of the DS1C digital line signal has 1,272 bits, including 24 control bits and a maximum of 2 stuffed bits in each digroup. For a 3.152-MHz clock rate, the maximum and minimum data rates of the digroup signal into the elastic store are derived as follows:

(a) Multiframes/second = 3,152,000 Divided by 1,272 = 2,478

(b) Control bit rate = 2,478 x 24 = 59,472 b/s

(c) Maximum digroup data rate (zero stuffing) = (3,152,000 - 59,472) Divided by 2 = 1,546,264 b/s

(d) Maximum stuffing rate per digroup = 2,478 x 2 = 4,956 b/s

(e) Minimum digroup data rate (maximum stuffing) = 1,546,264 - 4,956 = 1,541,308 b/s

5.158 The Xmt Intlk line, A or B, is normally grounded at pin 37 in the corresponding transmit unit. If that unit is unplugged, the output of the elastic store is forced to all 1s and the stuffing rate is set at one-half the maximum by stuffing only during subframe M1 or M2. This results in a transmitted digroup signal of 1,543,786 b/s.

5.159 **Transmit PCM Signal.** Digroups A and B are clocked out of the elastic stores by the 1.576-MHz clock and its complement. The two bit streams are interleaved to form a 3.152-Mb/s signal with every 53rd time slot reserved for a control bit.

5.160 The combined bit stream is scrambled (paragraph 5.128), control bits are inserted, and the signal is retimed to produce a return-to-zero signal. The bipolar converter routes alternate 1s to the two halves of the center-tapped transformer to provide consecutive output pulses with opposite polarity.

5.161 **Control Bit Selector.** The control bit selector decodes the three binary outputs of the control bit counter to select the applicable control bit from the six input ports as listed below. The sequence is M, Ca, F0, Cb, Cc, and F1.

(a) The normal pattern from the M-bit generator is 0111 in subframes M1 through M4, respectively, but changes to 0110 when Rem Alm goes high.

(b) Ca, Cb, and Cc are 0 in unstuffed subframes and 1 in stuffed subframes.

(c) F0 is fixed at 0 by zero volts (ground) and F1 is fixed at 1 by +5V.

5.162 **Timing.** The DS1C transmit frequency is controlled by a 3.152-MHz clock and the frame format is established by a string of tandem counters. The bit counter places a control bit time slot after every 52 data bits, the control bit counter places the six control bits in each subframe, and the subframe counter determines the length of the multiframe (four subframes).

5.163 The output of the first stage in the bit counter is 1.576-MHz, half the rate of the 3.152-MHz clock. The waveform in Figure 32a labeled "1.576 MHZ WITH GAPS" has an extra half-cycle between bit 52 and bit 1 that provides the control-bit time slots.

Syndes Unit Receive Section

5.164 **Receive PCM Signal.** In the input circuit (Figure 32b, upper right), the DS1C receive PCM signal is converted from bipolar to unipolar and a 3.152- MHz clock with its rising edges phase-locked to the center of the data bits is recovered. The retiming circuit produces a NRZ signal, and the descrambler restores the data to the state at which it entered the scrambler at the transmit terminal. The timing signal from the bit counter output causes the descrambler to reject control bits.

5.165 In the demultiplexer, data is separated into A and B digroup bit streams; stuffed bits are rejected. No attempt is made to adjust for jitter caused by removal of control bits and stuffed bits.

5.166 **Digroup Clock Generator.** The A and B clocks are obtained from a flip-flop that is set and reset on alternate cycles of the 3.152-MHz clock. An intermediate output of the bit counter steers the clock pulses alternately to the two flip-flops. The resulting 1.576-MHz A and B clocks are of opposite phase and modified as follows:

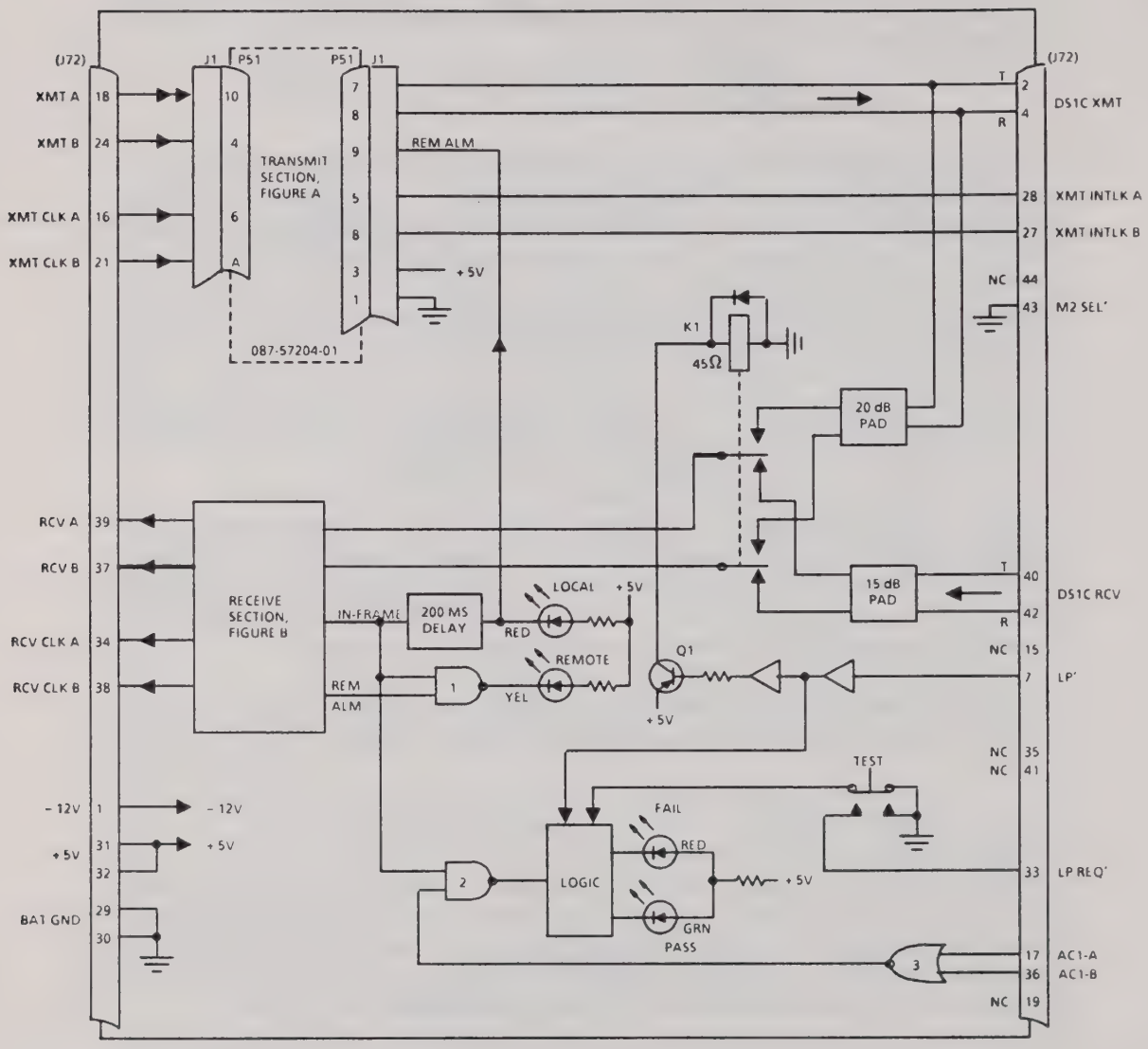
(a) Timing signals from the subframe counter and the C-bit detector prevent clock pulses during stuffed bit time slots.

(b) The bit counter output prevents clock pulses during control bit time slots.

5.167 **Timing Signals.** Timing signals in the receive section are controlled by the 3.152-MHz clock and developed in accordance with the frame format by a string of tandem counters. The bit counter emits a one-cycle pulse every 53 clock cycles; the count is inhibited during frame search or extended one count by a false frame inhibit.

5.168 The control bit counter produces clock edges during the center of the F, C, and M control bit time slots. Some additional timing signals produced during specific intervals but not shown on Figure 32b are: (1) between M and Ca, (2) between Ca and FO, and (3) between Cc and F1.

5.169 The subframe counter is clocked midway between M-bits to count the four subframes. Output pulses occur during M1 and M3 subframes.



NOTES:

1. Strapping. Insert three strapping plugs (sheet 2) in position B for 9004B.

2. Shelf Wiring. Receptacle connector J72 is occupied by a 91427 Line Interface Unit in Mode 1 or a 91426 Syndes Unit in Mode 2. On this diagram, pin numbers that are used on the 91427 but not on the 91426 are designated NC (no connection).

Figure 32. 91426 Model 2 Syndes Unit - Circuit Diagram (Sheet 1 of 3).

FIGURE 32a. TRANSMIT SECTION

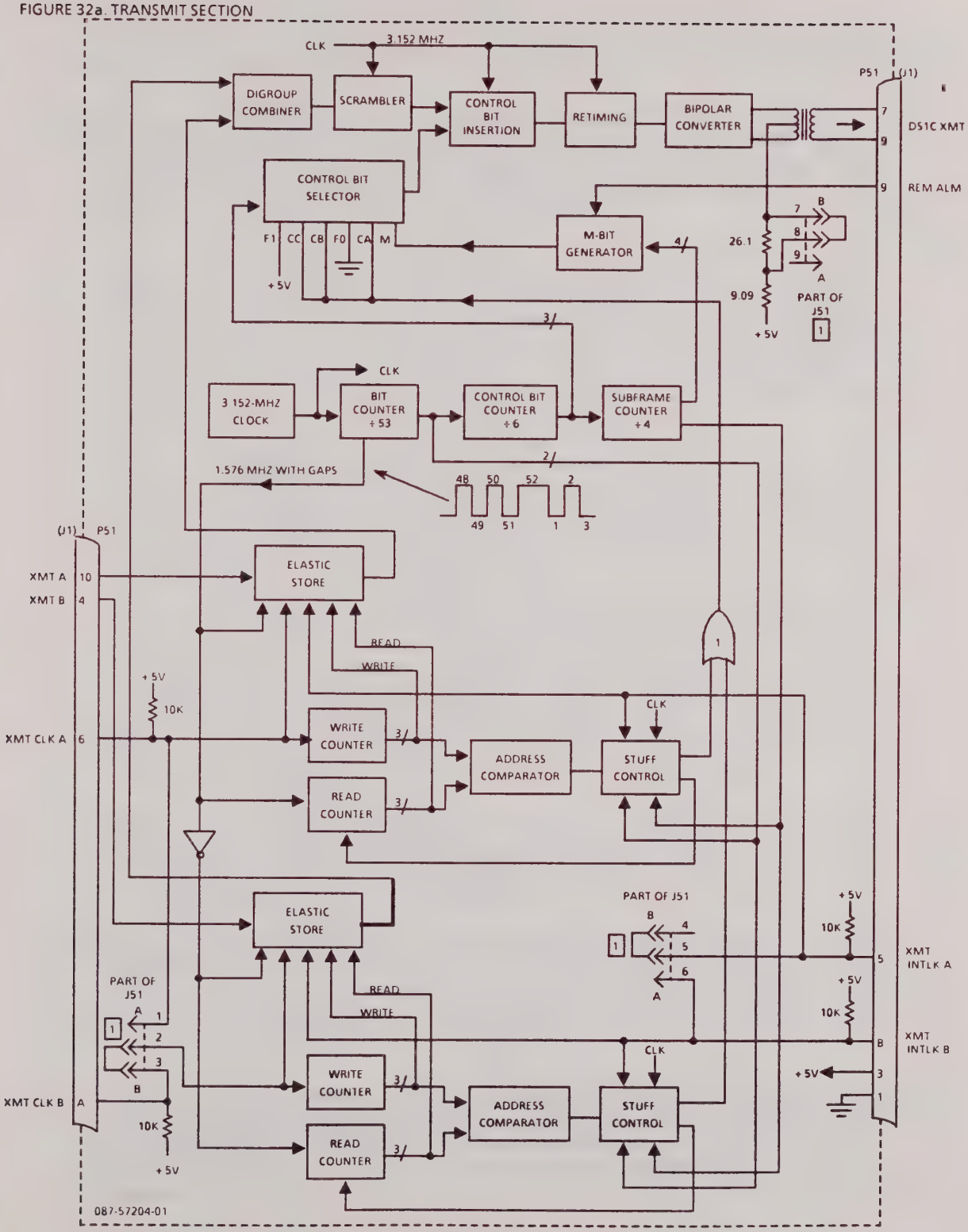


Figure 32. 91426 Model 2 Syndes Unit - Circuit Diagram (Sheet 2 of 3).

FIGURE 32b RECEIVE SECTION

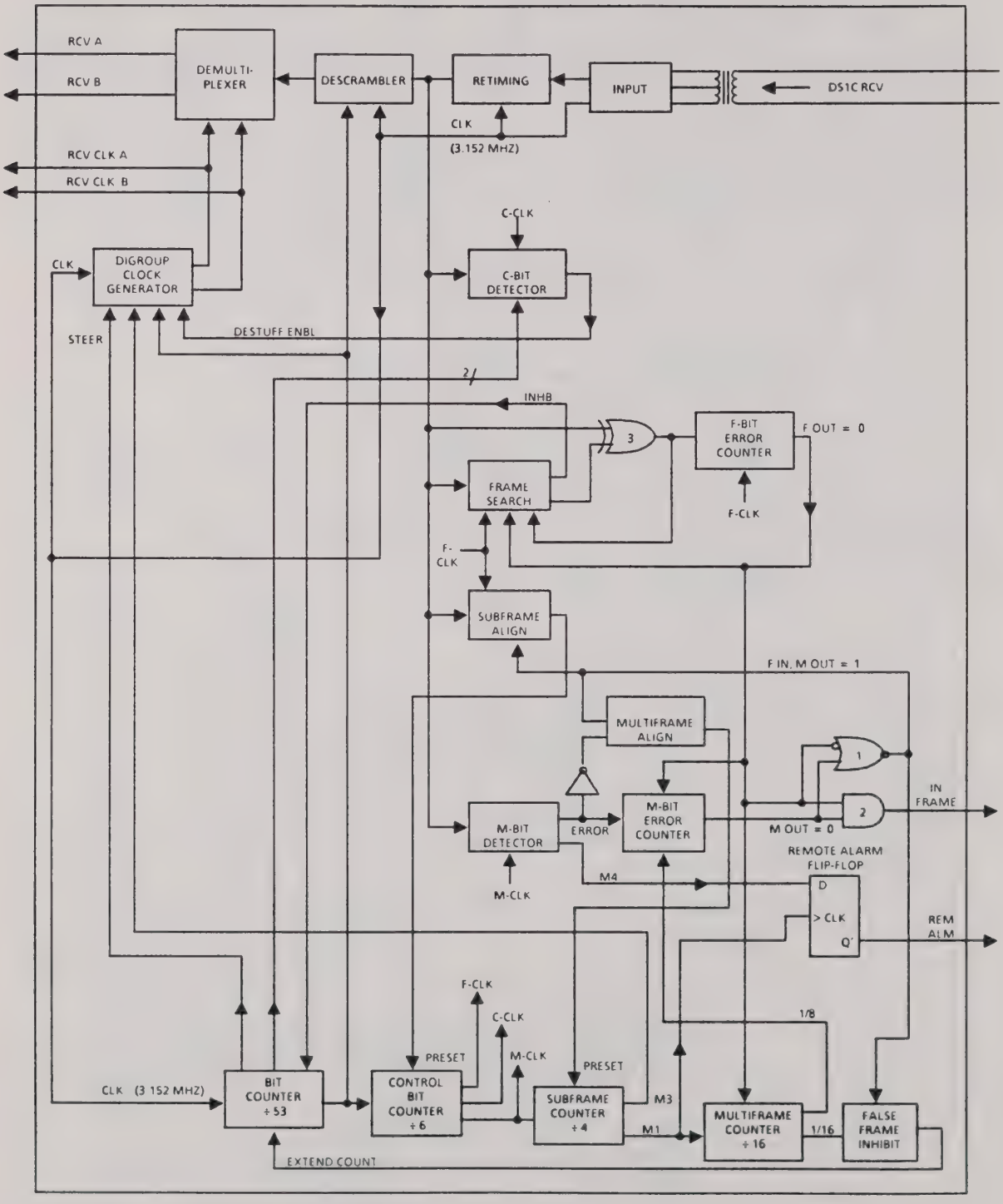


Figure 32. 91426 Model 2 Syndes Unit - Circuit Diagram (Sheet 3 of 3).

5.170 The multiframe counter produces an output pulse every 8 multiframes and another every 16 multiframes. Counting is suspended when F is out-of-frame.

5.171 **C-Bit Detector.** The C-bit detector monitors the main receive signal bus. If the majority of C-bits in a subframe are 1s, the output (Destuff Enbl) goes high four clock cycles after Cc and returns low six clock cycles after Cc. This provides the proper timing to inhibit clock pulses from the digroup clock generator during destuffing.

5.172 **Frame Search.** As shown in Figure 6d, F-bits are separated by 156 data bits (3 x 52) plus 2 control bits, and the F-bits have an alternating 1/0 pattern. When F is in-frame, consecutive F-bits are compared by exclusive-OR gate 3 and if they have the same state (0 or 1), an error pulse results. If there are more than three errors in the eight F-bits of a multiframe, the F-bit error counter output goes low to initiate a frame search. The first step in the search is finding the F-bit pattern.

5.173 When F is out-of-frame, the data bit from the F-bit time slot and the seven following bits are stored in a shift register. (The time slot locations are based on the local counters.) At the next F-bit time slot, eight new bits replace the eight bits stored in the shift register, one at a time, and corresponding bits are compared.

5.174 If the first bit comparison is correct, that bit and the next seven bits are stored, and the search moves to the next F-bit time slot location. If the comparison is incorrect (both bits are 1s or 0s), the local bit counter is inhibited for one clock cycle, which shifts the alignment of the local receive counters with the incoming data by one bit. This process is repeated until there is a correct comparison or until all eight bits have been tested. The search moves to the next F-bit time slot location.

5.175 If a correct comparison is not found in the first bit, an error pulse is output. The F-bit error counter tallies the pulses and resets at the end of each multiframe. When a multiframe has no errors, the counter output goes low as an in-frame indication.

5.176 **Subframe Align.** The subframe align circuit monitors the F-bit time slots and, at each F1 bit, outputs a presetting pulse that aligns the control bit counter with the subframe. This circuit is active only during the reframing process when F-frame alignment has been established but M is still out-of-frame.

5.177 **M-Bit Detector.** The M-bit detector is a shift register in which the last four M-bits received are stored. Bits M1, M2, and M3 are decoded during the Ca to F0 interval of subframe M3 and an error pulse is output if the pattern is not 011. Bit M4 is output separately to the remote alarm detector.

5.178 **Multiframe Align.** If F is in-frame and M is out-of-frame, when the M- bit detector output goes low in response to the correct M-bit pattern (011) in the receive signal, the multiframe align circuit presets the subframe counter to M3 and thus aligns it with the receive data multiframe.

5.179 **Remote Alarm Flip-Flop.** Control bit M4 from the receive signal is sampled by the remote alarm flip-flop during each M1 subframe. If M4 is 0 (alarm condition), the Rem Alm lead goes high.

5.180 The false frame inhibit circuit is clocked every 16 multiframes by the multiframe counter. If F is in-frame and M is out-of- frame when the circuit is clocked, the bit counter is extended one count during the Cb to Cc interval. This reinitiates the search for the alternating F-bit pattern to prevent false framing on a signal that has a repetitive 1/0 pattern in the data bits but does not have the correct M-bit pattern.

5.181 **M-Bit Error Counter.** This circuit counts error pulses from the M-bit detector and resets every eight multiframes. If the error count reaches three, the output goes low as an out-of-frame indication. Once M is out-of-frame, an error-free interval of eight multiframes is required to return to an in-frame condition.

5.182 When F is out-of-frame, the M-bit error counter output is forced low to the out-of-frame condition.

6. ALARM UNITS

6.01 Part 6 describes functional operation of the following units that process the channel bank alarm signals.

91420 Alarm Control Unit
91419 Remote Performance Interface Unit
91448 Office Interface Unit

91420 Alarm Control Unit

6.02 The 91420 Alarm and Control Unit (ACU) (Figure 33) monitors the following:

(a) Frame synchronization and bit error rate via AC1 from the 91418 TREU or the 91439 Receive Unit.

(b) System alarm status at the remote channel bank via AC2' from the 91418 TREU or the 91439 Receive Unit.

(c) Output voltages of the 91425 Power Supply Unit via the Pwr Alm lead.

NOTE: Fuse alarm inputs FA-A' and FA-B' are not used on the 9004B Channel Bank.

6.03 In Modes 2 and 3, each of the two alarm control units monitors AC1 and AC2' of the associated digroup; both units monitor Pwr Alm. In Mode 1, AC1-A and AC1-B are ORed in the line interface unit and routed to the single alarm control unit through a shelf strapping plug shown at the left side of Figure 33. Also in Mode 1, the other -A and -B alarm leads (AC2' through AC7) are connected together through strapping plugs shown at the right side of Figure 14.

6.04 Microcontroller U1 (paragraph 6.36) continuously samples the inputs described above and generates control signals and timing signals appropriate for normal or alarm condition. If an alarm condition occurs, the System Alarm (SA) relay is released to activate the office alarm circuits. The SYS ALM lamp lights and, if applicable, the LOC (local) or REM (remote) indicator lights. On a 91420-02 unit, a pulse through a 2-μF capacitor turns on a transistor momentarily to increment the SYS ALM peg count register.

6.05 When the channel bank is in system alarm, a loop test mode can be set up by the LOOP or TMB HOLD pushbutton. Micrcontroller U1 performs the necessary logic and timing functions.

6.06 Figure 34 is the alarm control unit timing diagram. Controls and indicators and input and output signals are described in paragraphs that follow and are summarized in Table 8.

6.07 **System Alarm (SA).** The SA relay, controlled from output port P17 of U1, is released by a power alarm immediately, by a local alarm after a 2.5-second delay, or by a remote alarm after a 450-ms delay.

6.08 With the SA relay released and the Alarm Cut Off (ACO) relay operated, the system alarm is maintained by operation of the TMB HOLD or LOOP pushbutton.

6.09 When the alarm condition clears, a 15-second software delay in U1 begins and must time out before SA relay can be operated again. After 15 seconds and the system alarm is being maintained by a remote alarm or by the TMB HOLD, the system alarm relay operates immediately when these conditions clear. If the system alarm is being maintained by a local alarm, power alarm, or LOOP pushbutton, the SA relay operates 15 seconds after clearance.

6.10 **External Alarms.** Three form-C contacts on the SA relay are available to control external audible, visual, and EAX alarms. With the SA relay released, momentarily depressing the ACO pushbutton latches up the ACO relay, restoring the audible alarm circuit to normal. The visual alarm circuit is also restored if the A/B strapping plug is in position A. When the SA relay operates, the ACO relay releases automatically.

6.11 **Local Alarm.** The AC1 lead from the receive unit or TREU is monitored by micrcontroller U1 at input port DB6, and samples at 5-ms intervals are integrated in software on the basis that out-of-frame = +2 counts and in-frame = -1. If the count reaches 24, corresponding to continuously out-of-frame for 60 ms, the LOC indicator is turned on from output port P11. The REM indicator is locked out by the software.

6.12 The +2/-1 of AC1 samples continues between the upper threshold of 24 and 0. If the count reaches 0 in less than 2.5 seconds, the local alarm clears. (See timing diagram, Figure 34.) Otherwise, a system alarm begins and the system alarm will clear 15 seconds after the local alarm clears.

6.13 In another software integration of AC1 samples, out-of-frame = +8 counts and in-frame = -1. If this count reaches 4096 (2.56 seconds out-of-frame), a local alarm is initiated and the following actions take place:

(a) Output port P17 of U1 goes to logic 1, releasing the SA relay. Contacts of the relay light the SYS ALM lamp and activate external alarms and the TMB1' (Trunk-Make-Busy) lead to the channel units.

(b) AC6' goes to logic 0, inhibiting channel signaling bits in the 91418 TREU or the 91439 Receive Unit.

(c) The +8/-1 integration counter is reset and will not be enabled until system alarm clears.

6.14 **Bit Error Rate (BER).** The preceding discussion of a local alarm was based on an out-of-frame condition in the TREU or receive unit as indicated by logic 1 on the AC1 line. During an in-frame condition, the receive unit outputs a 28-ms logic 1 pulse on AC1 each time an Ft framing bit is in error. If the bit error rate of the received PCM signal is greater than 10-3, the integration of AC1 samples will also result in a local/system alarm.

6.15 **Remote Alarm.** At the near channel bank, if bit 2 of a channel word in the incoming PCM signal is binary 1, the TREU or the receive unit outputs a positive logic pulse on AC2'. The normal AC2' signal is random pulses. (Bit 2 occurs every 5.07 or 5.18 μs, the length of a channel word.)

6.16 If the far channel bank goes into system alarm because of a local alarm or power alarm, the alarm control unit there activates AC4. This is done under software control through output port P15 of U1. In the TREU or transmit unit, AC4 forces bit 2 of all channel words to binary 0 ("bit 2 suppression").

6.17 At the near channel bank, the AC2' signal from the TREU or receive unit becomes steady logic 0. After a 410-ms hardware delay, input port DB1 of U1 goes to logic 0. If it remains so for at least 40 ms, under software control U1 lights the REM indicator through output port DB10 and sets AC3' to logic 0 through output port DB16. The function of AC3 (inverted AC3') is to mute the VF bits of channel words in the receive unit.

6.18 When AC2' returns to normal, AC3 becomes logic 0 after 30 ms and the REM indicator goes dark after an additional 70 ms.

6.19 **Simultaneous Remote and Local Alarms.** The REM indicator is locked out by lighting of the LOC indicator. But in the following special situation, REM and LOC can be on simultaneously. Assume a local alarm at the near channel bank and a consequent remote alarm at the far bank. If the near bank is looped for troubleshooting, it sends out an all-1s signal, which at the far bank initiates remote alarm time-out and local alarm time-in. This happens because the all-1's signal has bit 2s = 1 but does not contain framing information.

6.20 From the timing diagram (Figure 34), it seems that the system alarm at the far bank would time-out (30 ms) before the LOC indicator came on (60 ms). The local alarm timing has a 20-ms threshold at which an existing system alarm is maintained. Without the 20-ms threshold, REM would go dark and LOC would light. Instead, both indicators are lighted. Important troubleshooting information is not lost at the far end because of a procedure at the near end.

6.21 **Trunk Make Busy.** The alarm control unit supplies two trunk-make-busy signals (TMB1' and TMB2') and a timing signal (TP') to the channel units. One signal (TMB1') is controlled by the SA relay and the other two are generated by U1 under software control.

6.22 As shown on the timing diagram (Figure 34), TMB1' and TMB2' are steady logic 1 and TP' is a 50-ms logic 0 pulse every 12.5 seconds. At the onset of a system alarm, TMB1' is grounded by release of the SA relay. Following a 2.3-second delay, TP' goes to logic 0 for 50 ms, after which TMB2' goes to steady logic 0.

6.23 The function of the single 50-ms TP' pulse is to "wink" certain dial pulse originating (DPO) channel units to an idle state, dropping subscriber connections. After the pulse, the channel units return to the busy state for the alarm duration.

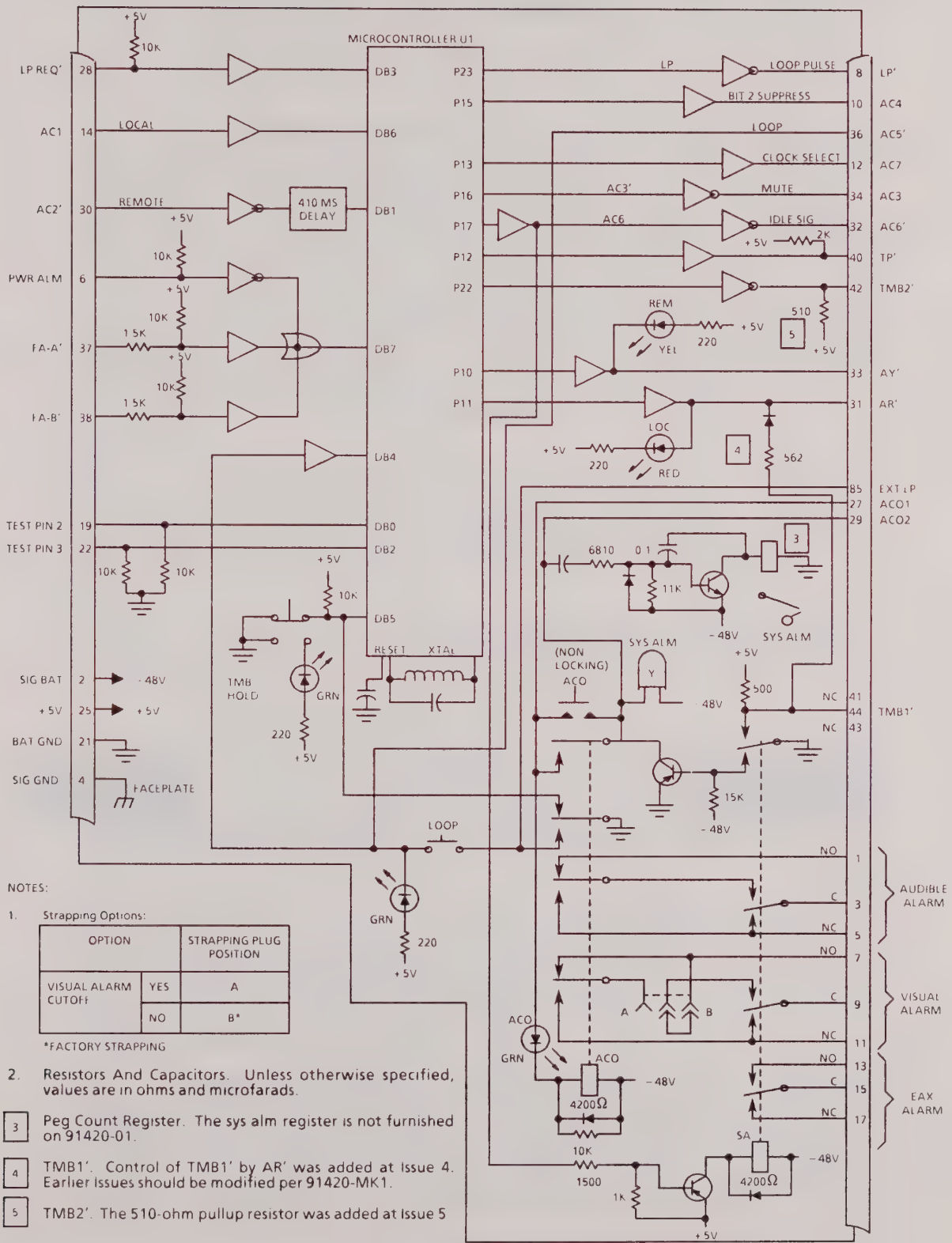
NOTES: The 91420 Issue 4 (and later issues), TMB1' is connected to AR' through a 562-ohm resistor and a diode. When a local alarm begins, ground on AR' pulls TMB1' down from +5 volts to +3 volts. Data channel units detect this and apply a "Mux Out of Sync" network control code to receive output signals. Other types of channel units do not react to the level shift on TMB1'; wait 2.5 seconds until TMB1' is grounded by a system alarm.

The circuit described above is added to earlier 91420 issues by Modification Kit 91420-MK1.

6.24 The TP', TMB1, and TMB2' buses from alarm control units A and B are wired to the channel units of digroups A and B, respectively. See Figure 15. The bus configurations are affected by the position of the strapping plug in J93 and by switching contacts on receptacle connectors J63 and J73 as follows:

(a) In channel bank Mode 1, which does not use alarm control unit B, corresponding A and B buses are connected together.

(b) In Mode 1, removal of unit A grounds the TMB1' and TMB2' buses.



NOTES:

1. Strapping Options:

OPTION		STRAPPING PLUG POSITION
VISUAL ALARM CUTOFF	YES	A
	NO	B*

*FACTORY STRAPPING

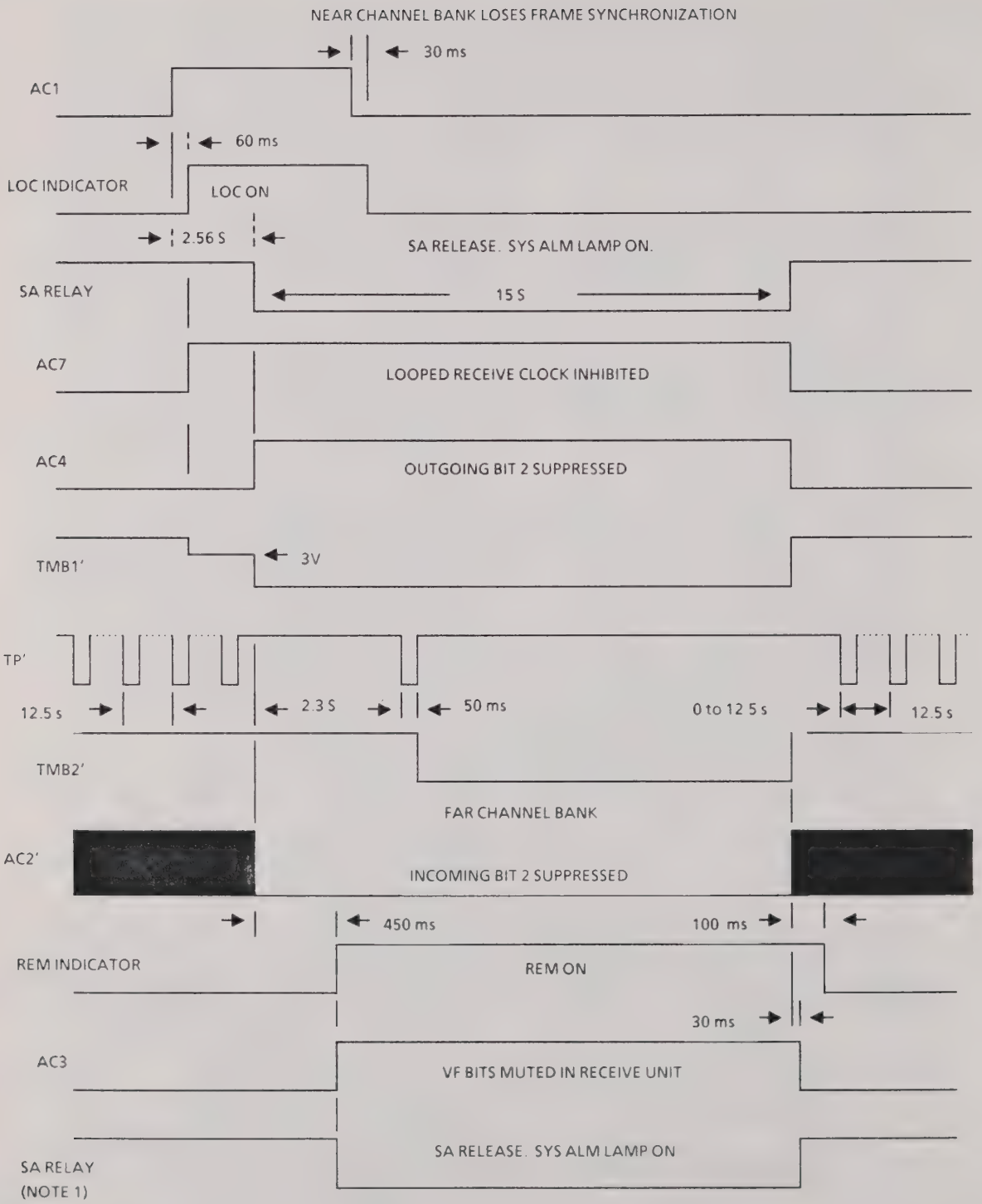
2. Resistors And Capacitors. Unless otherwise specified, values are in ohms and microfarads.

3 Peg Count Register. The sys alm register is not furnished on 91420-01.

4 TMB1'. Control of TMB1' by AR' was added at Issue 4. Earlier Issues should be modified per 91420-MK1.

5 TMB2'. The 510-ohm pullup resistor was added at Issue 5

Figure 33. 91420 Alarm Control Unit - Circuit Diagram.



NOTE 1. Far Channel Bank. TMB1, TP', and TMB2' at the far channel bank follow the SA relay as shown for the near channel bank

Figure 34. 91420 Alarm Control Unit Timing Guide.

(c) In Mode 2 or 3, removal of unit A or B grounds the TMB1' and TMB2' buses of the associated digroup.

(d) In Mode 2 or 3, removal of unit B connects the A and B TP' buses together.

6.25 **Looped Line (LL) Status.** With the SA relay released and the ACO relay operated, depressing the TMB HOLD pushbutton lights the TMB HOLD indicator and produces logic 1 at input port DB5 of U1. Through software, the system alarm is held and the REM indicator lockout feature is disabled. AC4 is activated through output port P15, causing the transmit unit to suppress bit 2 in the outgoing PCM channel words.

6.26 This channel bank status is useful in isolating trouble caused by intermittent or marginal signal conditions on the repeatered line. If the digital line signal is looped back at a repeater, the REM indicator lights if the line out and back is good and the LOC indicator lights if it is bad. (REM lights because bit 2 is suppressed in the signal sent out and returned.)

6.27 **Looped Terminal (LT) Status.** With the SA relay released and the ACO relay operated, depressing the LOOP pushbutton lights the LOOP indicator and grounds the AC5' lead to the transmit unit. The PCM signal from the transmit unit is switched to the receive unit input and an all-1s signal is sent to the line.

6.28 The logic 0 (ground) from the LOOP pushbutton also is applied to input port DB4 of U1. Software prevents the system alarm from clearing until the LOOP pushbutton is released.

6.29 **Remote Supervision.** At the right side of Figure 33, AY' (remote alarm, yellow) and AR' (local alarm, red) are outputs to the 91448 Office Interface Unit (OIU); ACO1/ACO2 and ExtLp are control inputs. The connections to the RPIU appear in Figure 19 and the connections to the OIU appear on Figure 20 and the circuits are described under the RPIU and OIU headings later in this Part.

6.30 **Looped Receive Clock.** With an active signal at micrcontroller U1's input port DB6 (AC1, out-of-frame), DB4 (LT status), or DB5 (LL status), AC7 is activated through output port P13. If the transmit or TREU unit is strapped for looped receive clock operation, AC7 causes a switch to internal clock as the transmit clock source. When the input ports are clear, U1 clears AC7 after 15-second delay.

6.31 **Loop Pulse.** Operation of the TEST pushbutton on the 91426 Syndes Unit grounds the LP Req' line, which is monitored by U1 at input port P03. If the digroup is in LT status, U1 generates a 300-ms logic 0 pulse on the LP' line via output port P23. In the syndes unit, the LP' pulse momentarily energizes a relay to loop the DS1C signal, transmit to receive.

6.32 In Mode 2, the LP' pulse and AC5' are logically combined in the transmit unit to produce a winked AC5' signal (WAC5'). The signal is used in the transmit unit and receive unit to momentarily unloop the DS1 signal of the applicable digroup.

6.33 The software performs a debouncing function for the TEST pushbutton and requires that the LP Req' line be normal for 50 ms after one LP' pulse ends before another can be generated.

6.34 **Test Pins.** Input ports DB0 and DB2 of U1 are used in factory testing.

6.35 **Reset.** The reset input of U1 is connected to ground through a capacitor and to +5V through an internal 200 k/ohm resistor. This ensures that U1 will have a reset pulse long enough to protect against operation with faulty data resulting from a supply voltage transient.

Microcontroller in the 91420 Alarm Control Unit

6.36 Logic and timing functions of the alarm control unit are performed by micrcontroller U1 (Figure 33). The micrcontroller is a single-chip device with the following characteristics as used in the 91420 application:

(a) Eight-bit central processor unit (CPU)

(b) Mask-programmed ROM (program memory): 1K x 8 bits

(c) Dynamic RAM (data memory): 64 x 8 bits

(d) Input ports: 8 lines of port DB

(e) Output ports: 9 lines of ports P1 and P2

(f) Internal clock: 1.5 MHz; frequency is controlled by an external coil and capacitor connected to the Xtal input

(g) Instruction execution time: 10 or 20 us

(h) Internal hardware timer: 82-ms period

6.37 **Instructions.** The micrcontroller operates in a continuous series of instruction cycles. In each cycle, the applicable instruction is derived from program memory and the operation specified by the instruction is performed. The main program is a continuous loop of more than 350 instructions. A complete loop is executed every 5 milliseconds.

6.38 **Flags.** Selected conditions that occur during program operation are stored as "flag" bits in one of three registers in RAM. For example, bit 2 of register R3 represents the status of the LOC indicator; binary 0 is normal and binary 1 is alarm.

6.39 **I/O Ports.** On the 91420 unit, DB of micrcontroller U1 is the input port and its eight lines are designated DB0 through DB7. The output ports are P1 and P2, but not all lines are used. Ports P10 and P11 are high-drive outputs capable of sinking 7 mA.

6.40 Data written to an output port is statically latched and remains intact until changed by another output instruction. Input ports are non-latching; that is, data must be present until read by an input instruction.

Table 8. 91420 Alarm Control Unit - Inputs, Outputs, Controls, and Indicators (Sheet 1 of 3)

	Name	Description
Inputs	AC1	Local alarm; indicates frame synchronization. Normal (in-frame) = logic 0 Alarm (out-of-frame) = logic 1
	AC2'	Remote alarm; indicates status of bit 2 in the incoming channel words. Normal = random logic 1 pulses Alarm = steady logic 0
	Pwr Alm	Power alarm; indicates status of 91425 Power Supply Unit. Normal = 0.4V Alarm = 2.4V
	LP Req'	Loop pulse request; grounded when TEST pushbutton on 91426 Syndes Unit is depressed.
Outputs	AC3	Mutes VF bits of channel words in the receive unit during a remote alarm. Normal = logic 0 Alarm = logic 1
	AC4	Suppresses bit 2 of channel words in the transmit unit during a local alarm or in looped line (LL) status. Normal = logic 0 Alarm = logic 1
	AC5'	Loop control; with SA relay released and ACO relay operated, depressing LOOP pushbutton grounds AC5'.
	AC6'	In the receive unit, forces signaling bits of channel words to idle during a system alarm. Normal = logic 1 Alarm = logic 0
	AC7	Switches the transmit unit timing source from looped receive clock (if so strapped) to internal clock; activated to logic 1 in a local alarm, looped terminal (LT) status, or looped line (LL) status;restores when system alarm clears.

Table 8. 91420 Alarm Control Unit - Inputs, Outputs, Controls, and Indicators (Sheet 2 of 3).

	Name	Description
Outputs	LP'	In LT status, activated from open to logic 0 for 300 ms by operation of TEST pushbutton on syndes unit; loops DS1C signal and unloops digroup signal(s).
	TMB1'	Trunk-make-busy signal to channel units. Normal = logic 1 (500-ohm pullup) System alarm = ground.
	TMB2'	Trunk-make-busy signal to channel units. Normal = open System alarm = logic 0 after end of single TP' pulse
	TP'	Timing pulses (logic 0 for 50 ms) to channel units. Normal = a pulse every 12.5 seconds System alarm = single pulse 2.3 seconds after alarm begins.
Inputs From 91419 Or 91448 IU	ACO1 and AC02	Closure between these leads is equivalent to operating the ACO pushbutton.
	ExtLp	Closure between ExtLp and AC5' is equivalent to operating the LOOP pushbutton.
Outputs To 91419 Or 91448 IU	AR'	Local alarm indication. Normal = logic 1 Alarm = logic 0
	AY'	Remote alarm indication Normal = logic 1 Alarm = logic 0
Outputs To Office	Audible alarm	Form-C contacts on normally-energized SA relay; alarm is restored by operation of ACO relay.
	Visual alarm	Form-C contacts on normally-energized SA relay; as a strapping option, alarm can be restored by operation of ACO relay.
	EAX alarm	Form-C contacts on normally-energized SA relay.

Table 8. 91420 Alarm Control Unit; Inputs, Outputs, Controls, and Indicators (Sheet 3 of 3).

	Name	Description
Control and Indicators	LOOP	Locking pushbutton and green LED. If SYS ALM lamp and ACO indicator are lighted depressing the LOOP pushbutton does the following: lights the LOOP indicator; loops the 48-channel (Mode 1) or 24-channel (Mode 2 or 3) digital signal from transmit to receive; transmits an all-1s signal to the digital line.
	ACO	Non-locking pushbutton and green (earlier issues had a white) LED. If SYS ALM lamp is lighted, depressing the ACO pushbutton operates the alarm cutoff relay and lights the ACO indicator. Relay operation disables the audible alarm and visual alarm (strapping option) circuits to the office but does not affect the EAX alarm circuit. The ACO relay releases automatically when the system alarm condition clears.
	LOC	Red LED. Indicates loss of receive signal, high error rate, or an out-of-frame condition. LOC has a 40-ms integration time, whereas FR SCH on the receive unit is instantaneous.
	REM	Yellow LED. Indicates the remote channel bank is in a system alarm condition initiated by a local alarm or maintained by an operated TMB HOLD pushbutton.
	TMB HOLD	Locking pushbutton and green LED. With the SYS ALM lamp and ACO indicator lighted, depressing the TMB HOLD pushbutton forces bit 2 of the transmit channel words to 0 and maintains the system alarm condition. The TMB HOLD indicator lights while the push- button is depressed. If the digital line signal is looped back, REM lights if the signal is received and framed upon; otherwise LOC lights.
	SYS ALM	Yellow lamp. Indicates a system alarm condition,which is initiated by a power, local, or remote alarm. With the alarm cutoff relay operated, a system alarm is maintained by an operated LOOP or TMB HOLD pushbutton.
	SYS ALM	Three-digit electromechanical totalizing counter with mechanical reset button (-02 only).

91419 Remote Performance Interface Unit (RPIU)

General

6.41 The 91419 RPIU is an optional unit used with the 9004B system. The unit can be used in standard frame format or extended superframe format. When used in the ESF format in conjunction with the TREU, the unit provides extensive performance monitoring of the DS1 spans, allows programming of the TREUs, and gathers alarm related information. If used in the SF format, the unit can only provide a local alarm for each digroup and relay this information to a supervisory system.

6.42 The RPIU also has a subassembly board that provides the DDS clock interface from an external DDS clock source or supplies DDS clock from the 9004B system to an external termination (these are mutually exclusive). The subassembly board also provides bit and byte synchronization signals to data channel units.

6.43 The 91419 RPIU mounts in the 91430 shelf as shown in Figure 1. Information is transmitted to and from the RPIU to the TREUs via two ribbon cables. The RPIU's faceplate has two 20-pin connectors for connecting a ribbon cable to each TREU (A and B). The shorter cable is pn 087-91499-01 and the longer cable is 087-91499-02.

6.44 The RPIU periodically gathers data on the occurrence of Loss of Signal (LOS), Out if Frame (OOF) and Alarm Indication Signal (AIS), CRC block errors, and the number of Bipolar Violations (BPV) received. This information is used to calculate the following Performance Monitoring (PM) parameters:

Line near Coding Violations (CV).
Line near and far Errored Seconds (ES).
Line near Severely Errored Seconds (SES).
Line near and far Bit Error Rate (BER).
Line near and far Error-Free Seconds (EFS).

Path near and far CV - mean value of Performance Report Message (PRM) range information (applies to far only).
Path near and far OOF.
Path near and far Framing Error (FE) - one per second maximum (applies to far only).
Path near Severe Framing Error (SFE).
Path near and far ES.
Path near and far SES.
Path near and far Unavailable Seconds (UAS) - without LOS because PRMs do not report LOS (applies to far only).
Path near and far Degraded Minute (DM).
Path near and far BER.
Path near and far EFS.

6.45 All Performance Monitoring (PM) parameters are tracked on an hourly, daily, and cumulative total basis. The BER parameter also has a current value associated with it and this is explained in detail under the PERFORMANCE command in 9004B ESF Users Guide, Section 342-911-550. All PM information is displayed via the RS-232-C and RS-422 craft interfaces. User-programmable thresholds are also assigned via this RS-232-C interface.

6.46 The RPIU assigns default values to the system during initialization. These default values are those specified by TR-TSY-000475 and are listed in Table 9.

6.47 The faceplate of the RPIU has three LEDs (two yellow and 1 red), a pushbutton, and two 20-pin connectors. A red LED (RPIU Alarm) reports a failure in the RPIU or lights temporarily during initialization. The two yellow LEDs are the degraded performance alarms which report when a threshold for their respective digroup has been reached. The RPIU RESET pushbutton is provided to allow resetting of the RPIU hardware and software during an extreme failure condition. Two 20-pin connectors provide the physical interface from the TREUs to the RPIU.

User Monitoring and Programming

6.48 Information on monitoring and programming the 9004B system via the RPIU is contained in Section 342-911-550, 9004B ESF User's Guide. The guide provides information for setting the date and time, passwords, system parameters, alarm reports, and looping.

6.49 The RPIU provides two ports for communication of performance monitoring and alarm information. The first is an RS-232-C port which has a physical interface requiring only a TxD, RxD, and signal ground lead. The port operates at 1200 baud, provides an asynchronous serial interface, and possesses a proprietary command interface. The interface is compatible with Interface D of the RS-232-C specification. Interface D requires seven mandatory signals which the RPIU supplies (refer to Table 10).

6.50 This RS-232-C port may be connected directly to a local terminal, or to a remote terminal via Siemens' CRT Switching Unit (CSU), CRT Maintenance Shelf (CMS) and/or a modem. The terminal may be any type but must be able to emulate a VT-100 mode. The recommended terminal is the WYSE-50. Refer to Section 342-930-100 for more information on the CMS equipment.

6.51 The second port is an RS-422 with a Telemetry Byte Oriented Serial (TBOS) protocol. The TBOS interface (2400 baud) is provided for use in conjunction with an external Data Collection Processor (DCP) in the central office. The DCP polls each piece of equipment it is connected to periodically and gathers performance information over the RS-422 port. This performance information is then relayed back to a maintenance center or Operation Support System (OSS).

6.52 The TBOS port operates asynchronously and is configured to comply with the Type DT interface specified in the EIA specification. Type DT represents only data and timing. The RPIU does not require the timing signals so it only provides data in and out, and a signal ground.

Alarm Reporting

6.53 The RPIU periodically (once every 3 to 4 seconds) checks the signal to ensure performance thresholds have not been exceeded. Performance monitoring thresholds and default values are listed in Table 9. When a threshold has been exceeded, a message is sent to the RS-232-C interface, the RS-422, and the DP relay, and the degraded performance LED is lit. In addition, if the DP alarm has been programmed accordingly (via the CONFIG command) the alarm is sent to the corresponding TREU and ACU, and the digroup goes into a system alarm. The DP feature also provides a DP relay that energizes the normally open or closed contacts, located on the backplane, which can be used for customized alarm reporting.

6.54 The user may enable or disable any parameter to assert a DP alarm and ultimately a system alarm.

6.55 When a 9004B alarm occurs, or an hourly, daily, or total performance threshold is exceeded, the event is stored in non-volatile memory of the RPIU along with time and date of the occurrence. This allows the user to poll alarm history at any time and determine the performance quality of the system. The alarm history file is capable of storing up to 49 events (47 hardware and 2 software) in memory. The alarm history table is a First In, First Out (FIFO) operation for data collection and a Last In, First Out (LIFO) operation for data reporting. After 47 hardware events occur, the 48th event will automatically overwrite the first event. During display, the latest event will be shown first. The two software history events work the same as the hardware events.

Loopbacks

6.56 When TREUs are configured for the ESF option, local, remote and payload (path) loopbacks can be requested from a CRT terminal via the RPIU (Figure 8). The request for loopback is received via the RS-232-C or RS-422 port and fed to the main controller. The main controller sends a message to the appropriate TREU through the control/senses register and the appropriate loopback is activated. Verification is provided for both line and payload loopbacks at the far end RPIU.

NOTE: The system must be in an alarm condition to execute a local (line) loopback via the RPIU or 91420 unit.

6.57 Local loopback may also be requested from the alarm and control unit via the LOOP pushbutton. The control/status register senses the loopback and forwards the information to the main processor.

Functional Operation

6.58 **Main Controller.** The main controller (Figure 35) combines several of the functions required by the RPIU (internal chip select, address decode, programmable timers, and internal clock generation) and controls most of the operations of the RPIU. This controller is an interrupt driven device and continually monitors the status of the 91418 TREU until interrupted by an incoming message.

6.59 The main controller addresses up to 1 Megabyte of address space [both memory and Input/Output (I/O)]. The internal chip select capabilities of the main controller are utilized to provide both memory and chip select outputs for devices on the RPIU and devices connected to the RPIU via the TREU cable interfaces.

6.60 **Address Bus.** The address bus contains 18 leads and lets the appropriate device on the RPIU or TREU know that the main controller is addressing it. The bus signals from the main controller are buffered to make the signals compatible with the address inputs of the RPIU devices.

6.61 **Watchdog Timer/Power Monitor.** A watchdog timer/power monitor performs three functions:

(a) When the power to the RPIU falls below 4.5Vdc, a reset signal is asserted. If the power level does not rise to 4.75Vdc for 250 msec, the RPIU will go into alarm.

(b) When a strobe signal from the main controller is not received every 150 msec, the watchdog timer/power monitor will reset the main controller.

(c) When the reset pushbutton on the faceplate of the RPIU is depressed, the watchdog timer/power monitor will reset the main processor.

6.62 **Internal Timer Configurations.** The main controller utilizes three internal timers. In the RPIU, Timer 0 causes an interrupt every second. This is used for transmitting the Performance Report Message (PRM) over the ESF data link. Timer 1 causes an interrupt every 3 mseconds. This is used for polling both TREUs in the 9004B system and obtaining error performance information once for every ESF. Timer 2 is used as a prescaler for Timer 0.

6.63 **Program and Data Memory.** The RPIU is equipped with the following memory:

(a) 128K of EPROM. Used for program memory.

(b) 32K of RAM. Used for data memory.

Table 9. 91419 Performance Monitoring Parameter Default Values.

PM Parameter	Default Threshold		
	Hourly	Daily	Total
Line Coding Violation (CV)	53,360 *	133,400 *	1,000,000
Path Coding Violation (CV)	53,184 *	132,960 *	1,000,000
Errored Second (ES)	259 *	648 *	10,000
Severely Errored Second (SES)	40 *	100 *	1,000
Out Of Frame (OOF)	7 *	17 *	1,000
Framing Error (FE)	500	10,000	50,000
Severe Framing Error (SFE)	500	10,000	50,000
Unavailable Seconds (UAS)	10 *	10 *	100
Degraded Minute (DM)	15 *	360 *	1,000
Bit Error Rate (BER)	1E – 6	1E – 6	1E – 6
Error-Free Seconds (EFS)	95%	95%	95%

* These values are specified in Bellcore document TR-TSY-000475.

(c) 2K Non-volatile RAM. Used for storage of system parameters, alarm and status information, and performance data. Information is retained through power down or power failure conditions.

6.64 **ESF Data Link Messages.** The TREU cable interfaces give the RPIU (main controller) access to a 4-kb/s facility data link on each digroup. The signals RLINK, RLCLK, TLINK, and TLCLK signals are utilized to communicate transmit and receive information between the RPIU and the framers on the TREUs. The framer in each TREU provide the actual interface to the ESF data link. Two types of messages are communicated over the 4-kb/s data link:

(a) Repeated bit-oriented signals (codes). Bit-oriented messages are the various loopback activation/deactivation requests.

(b) Message-oriented signals which are transmitted using the Link Access Procedure for the D-channel (LAPD) protocol (sends PRMs). LAPD is a subset of High-Speed Data Link Controller (HDLC) protocol. The High -Speed Communications Controller (HSCC) contains two HDLC data link controllers. Message-oriented signals are PRMs.

6.65 **Transmit Message Hardware.** The RPIU transmits bit-oriented messages to the TREU and onto either of the two ESF channels in the 9004B. The transmit hardware functions as follows:

(a) The RPIU is instructed by a user to initiate a line or payload loopback. The RPIU first determines that no other loopbacks are currently in progress on the digroup.

(b) When the main controller determines that a loopback may take place, the RPIU transmits a bit-oriented message over the 4-kb/s data link of one of the two channels to the transmit message load buffer.

(c) The data is then clocked out serially by the signal TLCLK'.

(d) When the serial code is generated from the transmit shift registers, the RPIU disables the HSCC output and enables the bit-oriented serial output onto the signal TLINK.

(e) The bit stream on the data line TLINK is then passed over the cable interface and onto the TREU where it is clocked into the framer and onto the TLCLK signal. The signal then passes to the ESF data link.

(f) The RPIU allows the data link messages to repeat at least 10 times before the messages are disabled.

6.66 The RPIU verifies correct transmission and far-end recognition in two ways:

(a) For line (remote) loopbacks, the RPIU receives the same bit-oriented message back that was transmitted.

(b) For path (payload) loopbacks, the PRMs are used to communicate that the loopback has been established.

6.67 **Receive Message Hardware.** Data received by the framer of each TREU is clocked over the corresponding cable interface and into the RPIU. The data is simultaneously clocked into the receive channels of the HSCC and into the receive bit-oriented message hardware. The HSCC is watching for a LAPD-type message and will only respond to this format. The receive hardware functions as follows:

(a) Data is clocked into both the receive channels of the HSCC and into registers of receive hardware at the same time. This occurs on the rising edge of RLCLK.

(b) The parallel output of the registers is then read and initiates an interrupt latch which is fed to the main controller.

(c) The main controller responds by reading the interrupt request register. If the main controller determines the interrupt to be one of the bit-oriented message hardware circuits, it first clears the associated interrupt by writing the memory location associated with the memory region.

NOTE: Bit-oriented message interrupts cannot occur more than once every four mseconds for each channel; therefore, the main controller has approximately four mseconds to respond to a bit-oriented message interrupt.

(d) The main controller reads the message code.

NOTE: The RPIU software ignores any loopback requests received over the ESF data link if loopback codes are being transmitted over the data link. The reception of these loopback bit messages are interpreted as a loopback acknowledgement, but not processed.

6.68 **Serial Port Maintenance Interface.** The RPIU is equipped with two serial ports (RS-232-C and RS-422) used to convey performance-related information to maintenance systems and terminals external to the 9004B (Table 10). These serial ports are provided via an Advanced Multiprotocol Serial Controller (AMPSC) device.

6.69 Internal registers are used to set the AMPSC operation and indicate the device status. The AMPSC has control registers for each of its two channels used for setting the operation mode and control. The AMPSC also has status registers. Control registers write only and status registers are read only.

6.70 **Control/Status Registers.** In addition to the control points and sense registers which the RPIU has access to over the cable interfaces to the TREU, the RPIU contains several dedicated registers allocated for control/status functions within the RPIU. Some of these functions were described in the transmit and receive message hardware described earlier.

6.71 The control/status registers collect information and control the operation of the RPIU via the main controller. Referring to Figure 35, the LOOP/ACO activity of the 91420 unit is also sensed by the control/status registers located in the RPIU. Circuitry on the RPIU interfaces with the 91420 ACU. The RPIU initiates ACO and Local Loopback via this circuitry.

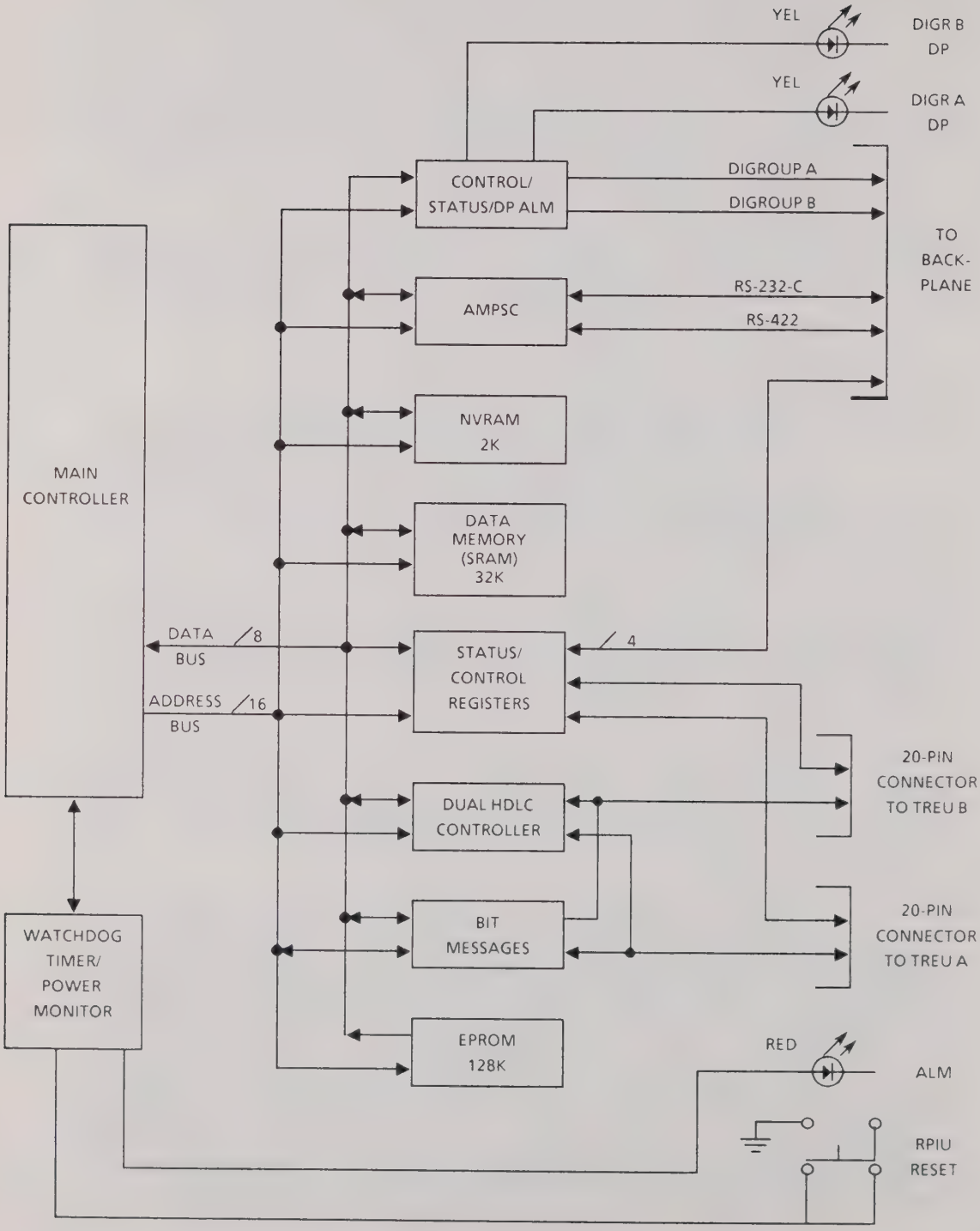
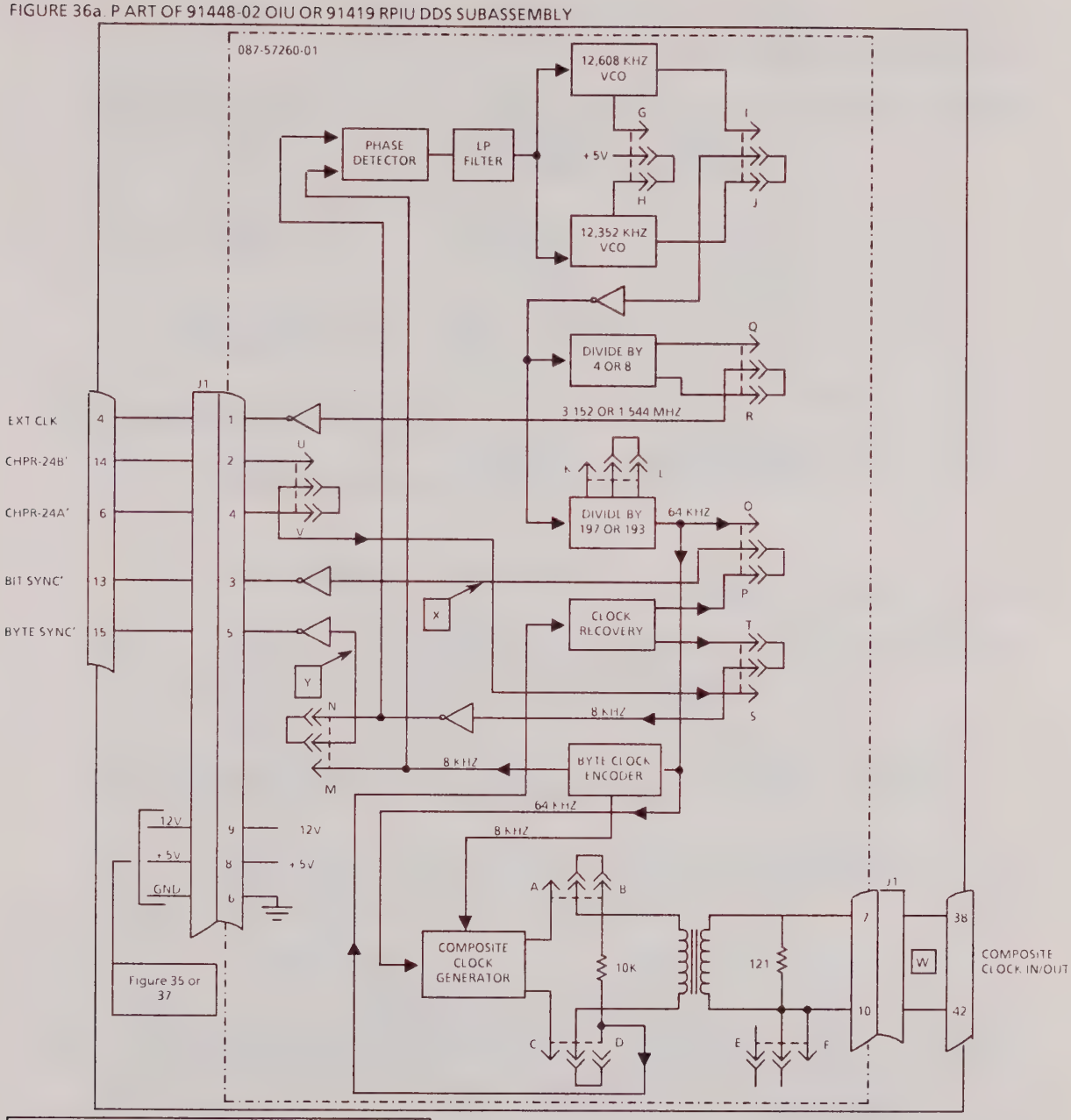


Figure 35. 91419 Remote Performance Interface Unit - Block Diagram.

FIGURE 36a PART OF 91448-02 OIU OR 91419 RPIU DDS SUBASSEMBLY



OPTION		STRAPPING PLUG POSITION
CHANNEL BANK MODE	1 2 OR 3*	G, I, K, Q H, J, L, R
COMPOSITE CLOCK SOURCE	INTERNAL EXTERNAL*	A, C, M, O, S B, D, N, P, T
INTERNAL CLOCK SYNC	DIGROUP A* DIGROUP B	V U
COMPOSITE CLOCK INPUT	BRIDGING* TERMINATING	E F

*FACTORY STRAPPING

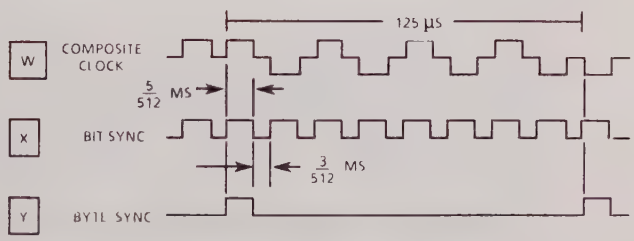


Figure 36. 91419 RPIU and 91448-02 OIU DDS Subassembly (Sheet 1 of 2).

FIGURE 36b COMPOSITE CLOCK INPUT OPTION

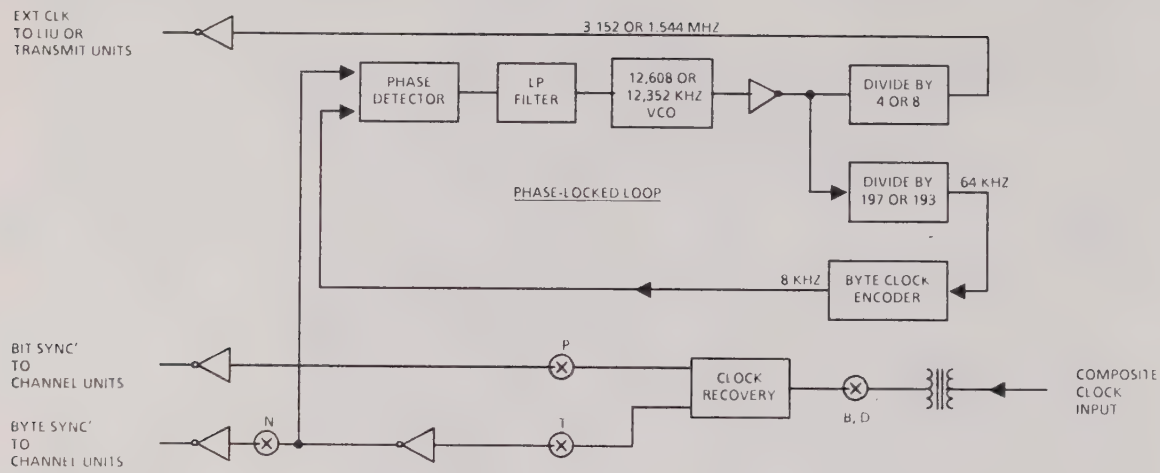


FIGURE 36c. COMPOSITE CLOCK OUTPUT OPTION

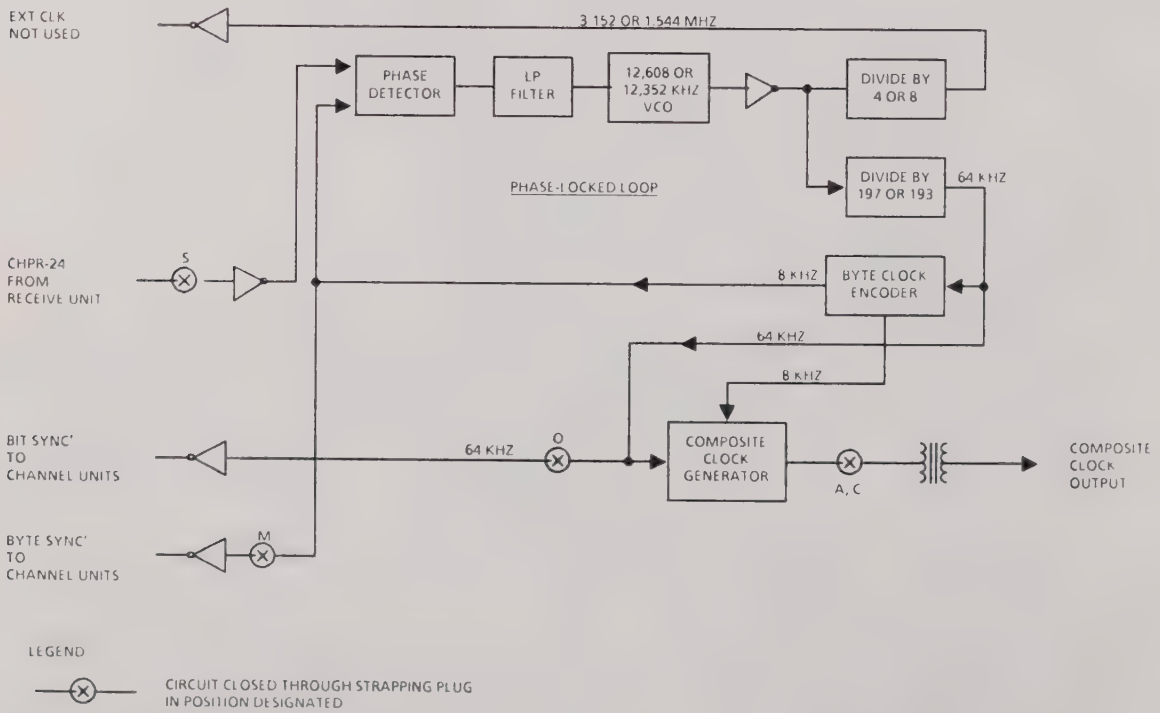


Figure 36. 91419 and 91448-02 OIU DDS Subassembly (Sheet 2 of 2).

Table 10. 91419 RPIU Supervisory System Interfaces.

	Name	Description
RS-232-C leads to OSS	TXD232 (TD) RTS232 (RTS) DTR232 (DTR)	Transmit Data Request to Send Data Terminal Ready
RS-232-C leads from OSS	RXD232 (RD) CTS232 (CTS) DSR232 (DSR) DCD232 (DCD)	Receive Data Clear to Send Data Set Ready Data Carrier Detect
RS-422 leads to OSS	TXD422A (TD-A) TXD422B (TD-B)	Transmit Data A Transmit Data B
RS-422 leads from OSS	RXD422A (RD-A) RXD422B (RD-B)	Receive Data A Receive Data B

* EIA Standard designations are shown in parenthesis.

DDS Subassemly Board (91419 and 91448-02).

6.72 Subassembly 087-57260-01 comprises part of the RPIU and the -02 option of the 91448 unit. This subassembly generates timing signals required for DDS at a hub or tandem office (Figure 26, Sheet 2).

6.73 **Phase-Locked Loop.** The central element of the timing circuits is a voltage-controlled oscillator (VCO) in a phase-locked loop. Strapping plugs G/H and I/J select a 12,352-kHz VCO for Mode 3 (Figure 36, Sheet 1).

6.74 Dividing 12,352 kHz by eight yields the 1.544-MHz clock required by the TREU units in Mode 3. The clock, selected by the Q/R strapping plug, exits at pin 4 on the Ext Clk line.

6.75 Dividing 12,608 kHz by 197 or 12,352 kHz by 193 gives 64 kHz, which the byte clock encoder stage further divides to 8 kHz. A phase detector compares this 8-kHz signal with an 8-kHz signal derived from the master timing source, and develops a dc voltage proportional to phase difference. The DC voltage goes through a lowpass filter to varactor diodes in the VCO. These diodes pull the VCO frequency into sync with the master timing source.

6.76 When the RPIU has a composite clock input, this clock contains the master timing information referred to in the preceding paragraph. If the RPIU outputs a composite clock, the 8-kHz receive channel pulse signal (ChPR-24A' or -24B', selected through the U/V strapping plug) provides the master timing information.

6.77 **Composite Clock.** The composite clock is a 64-kHz bipolar waveform with a 5/8 duty cycle (Figure 36, Sheet 1). Every eighth pulse violates the bipolar rule by being the same polarity as the preceding pulse. The basic waveform contains the 64-kHz bit sync information and the bipolar violations contain the 8-kHz byte sync information.

6.78 **Composite Clock Input Option.** The composite clock (Figure 36b), entering at the right of the circuit diagrams, goes through A/B and C/D strapping plugs to the clock recovery stage. The input circuit may be bridging (10k ohms) or terminating (121 ohms), according to the position of the E/F strapping plug.

6.79 Bit sync and byte sync signals recovered from the composite clock go through O/P and S/T strapping plugs and exit to the channel units at pins 13 and 15. The 8-kHz byte sync signal also goes to the phase comparator to synchronize the VCO.

6.80 The base-to-peak amplitude of a composite clock input is 2 to 4 volts; the output is 4 volts. Bit sync and byte sync signals are TTL levels.

6.81 **Composite Clock Output Option.** The 64-kHz output (Figure 36c) of the 197/193 divider goes through the O/P strapping plug and becomes the bit sync signal to the channel units. The 8-kHz signal from the byte clock encoder goes through the M/N strapping plug and becomes the byte sync signal to the channel units.

6.82 At the composite clock generator, an auxiliary 8-kHz input from the byte clock encoder forces bipolar violations on the 64-kHz input to create the composite clock waveform. The clock goes through the A/B and C/D strapping plugs and exits at pins 38/42.

91448 Office Interface Unit (OIU)

6.83 The -01 version of the OIU is a single PC board interfacing the 91420 Alarm Control Units with a supervisory system (Figure 37). Table 11 summarizes the alarm and control functions.

6.84 The -02 version of the OIU provides an additional PC board (subassembly 087-57260-01) that generates the timing signals required for digital data service (DDS) at a hub or tandem office. This circuitry is identical to the DDS subassembly PC board on the 91419. Refer to Figure 36, sheet 1 for a circuit diagram.

6.85 **External Local and Remote Alarms.** Alarm signals from the 91420 units are shown at the left of Figure 37, remote alarms on AY-B' and -A' and local alarms on AR-B' and -A'. The signals go through an inverter and NOR gate 7 to an open-collector transistor. An alarm condition (logic 0) on AY' or AR' turns on the transistor, grounding the external alarm lead.

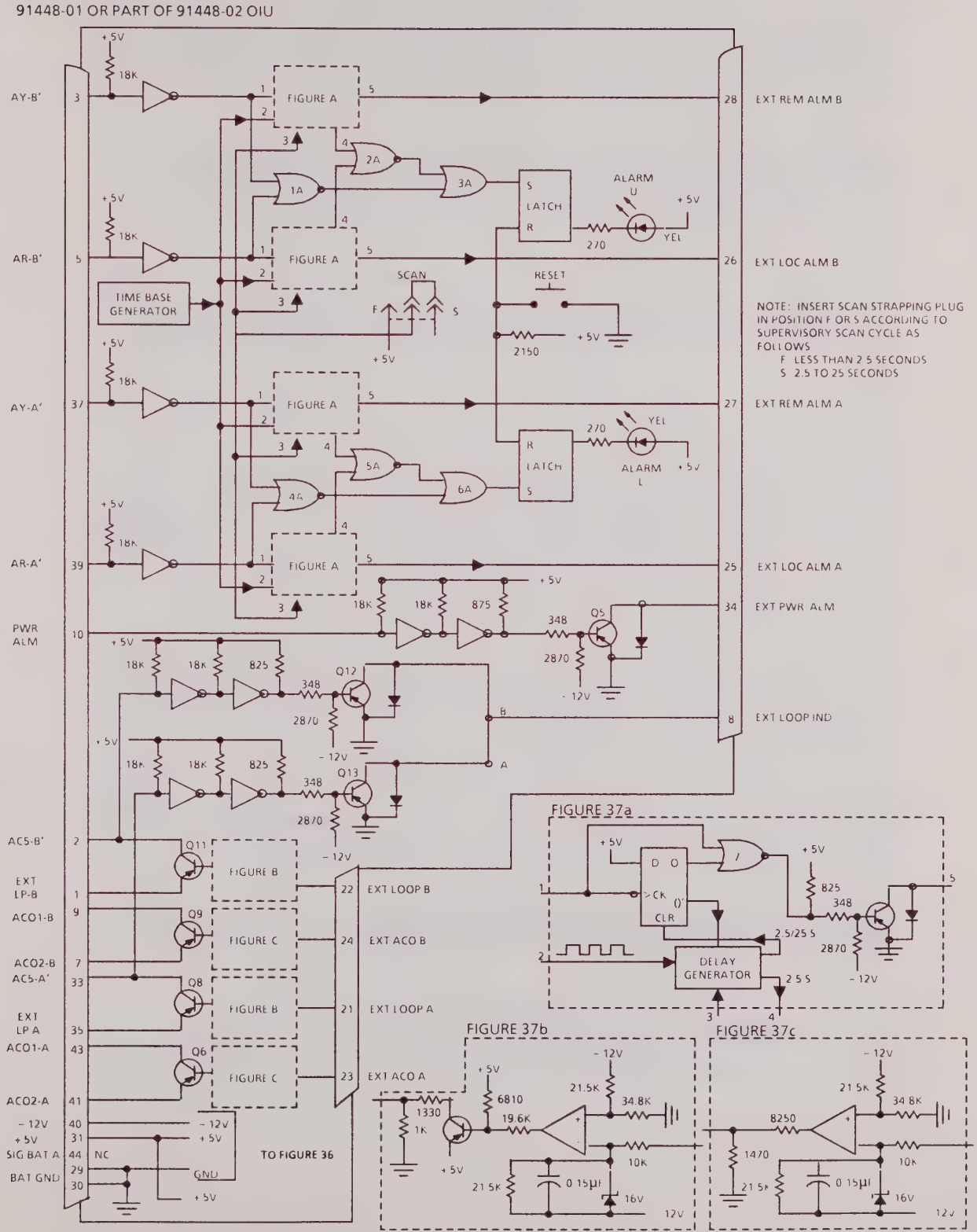


Figure 37. 91448 Office Interface Unit - Circuit Diagram.

6.86 The high-to-low transition of the alarm signal clocks the D-type flip-flop (Figure 37a), making the Q output logic 1. Enabled by logic 0 on the Q' output, the delay generator counts time base pulses and clears the flip-flop after 2.5 or 25 seconds, according to the SCAN strapping plug position, F (fast) or S (slow).

6.87 The external alarm is controlled by two inputs of gate 7. The input from the flip-flop ensures that short-duration alarms between successive scans by the supervisory system are not missed.

6.88 **Alarm Indicators.** Gates 1A, 2A, and 3A logically combine the digroup B alarm signals and the 2.5-second timing signals from the delay generators. If an alarm condition is present for at least 2.5 seconds, gate 3A sets the latch, lighting the yellow ALARM U (upper) indicator. Depressing the RESET button clears the latch; the indicator then goes dark.

6.89 A similar circuit using gates 4A, 5A, and 6A controls the ALARM L (lower) indicator.

6.90 **External Power Alarm.** With DC power present in the OIU and the Pwr Alm input normal (logic 0), transistor Q5 turns on and grounds pin 34. Power interruption or a blown fuse turns off Q5, removing ground on the Ext Pwr Alm lead to the supervisory system. Because a power failure is never momentary, this alarm is not latched in the OIU.

6.91 External Loop Indication. Looping a digroup, either locally or via the supervisory system, grounds the AC5' lead. Transistor Q12 or Q13 turns on, grounding the Ext Loop Ind lead monitored by the supervisory system.

6.92 **External Loop Control.** When the channel bank is in system alarm, the digroups can be looped from a remote location via the supervisory system. Control leads Ext ACO and Ext Loop are normally open. Ground on the control lead switches on the output transistor (Q6, Q8, Q9, or Q11).

6.93 The following is a typical sequence in a command to loop digroup A, which is assumed to be in system alarm.

(a) Supervisory system grounds Ext ACO A.

(b) Transistor Q6 closes ACO1-A to ACO2-A (the same as depressing the ACO pushbutton on the alarm control unit).

(c) Supervisory system grounds Ext Loop A.

(d) Transistor Q8 closes ExtLp-A to AC5-A' (the same as depressing the LOOP pushbutton on the alarm control unit).

NOTE: The remainder of the OIU description pertains only to 91448-02, Figure 36 Sheet 1. Figure 36, sheet 2 is a simplified diagram of the composite clock input and output options. Refer to paragraph 6.72 for the description of the 91448-02 option.

Table 11. 91448 Office Interface Unit- Supervisory System Interface, Controls, and Indicators.

	Name	Description
Alarm Leads to Super-visory System	Ext Rem Alm and Ext Loc Alm (A and B)	Normally open. Ground is applied immediately by a change from normal to alarm on AY' (remote) or AR' (local). Ground remains 2.5 or 25 seconds (strapping option) or until the alarm condition ends, whichever is longer.
	Ext Pwr Alm	Normally grounded. Ground is removed by DC power interruption.
	Ext Loop Ind	Normally open. Ground is applied if loop control line AC5-A' or -B' is activated.
Control Leads from Super-visory System	Ext ACO (A and B)	Ground on Ext ACO closes ACO1 to ACO2, operating ACO relay on alarm control unit if channel bank is in system alarm.
	Ext Loop (A and B)	Ground on Ext Loop closes ExtLp to loop control line AC5'. If channel bank is in system alarm and alarm cutoff condition, AC5' is activated.
Controls and Indicators	ALARM U (digroup B) and ALARM L (digroup A)	Yellow LED. Lights 2.5 seconds after alarm on AY' or AR'. Cleared by RESET button, but lights again if alarm still exists.
	RESET	Non-locking pushbutton. Clears yellow alarm indicators.

7. SPECIAL TEST EQUIPMENT

7.01 Part 7 describes functional operation of the following test equipment designed for 9004A/B channel bank maintenance.

91442 VF Test Set
91443 Test Patch Panel
91445 Signaling Path Test Set

7.02 Another item of special test equipment, the 9140A Digital Test Set, is covered in Section 342-911-125.

91442 VF Test Set

7.03 The 91442 VF Test Set (Figure 38) has two independent sections, L on the left and R on the right, and a common center section. For end-to-end channel performance tests, the TEST receptacle connector on the channel unit is patched to the CHANNEL UNIT receptacle connector in Section L or Section R, as specified in the test procedure. For loop tests, one channel unit is patched to Section L and the other to Section R. Patching is done with 12-conductor 796A Patch Cords.

7.04 The XMT-RCV toggle switch (S9) in the center section has two positions: L-R and R-L. In position L-R, an analog test tone from the internal oscillator, or an external oscillator, is routed to the transmit input of the channel unit patched to Section L. The receive output of the channel unit patched to Section R goes to the LEVEL, DISTN, and CRSTLK jacks. An external meter is connected to the applicable jack as specified in the test procedure. The internal test set circuits include a 1020-Hz band elimination filter at the DISTN jack and a 1020-Hz bandpass filter at the CRSTLK jack.

7.05 By setting switch S9 to position R-L, the direction of transmission described above is reversed. The test tone then goes to the transmit input of the channel unit patched to Section R, and the receive output of the channel unit patched to Section L goes to the external meter. The L-R and R-L configurations are set up through contacts of XMT-RCV switch S9 and relays K1 and K2, one of which is operated in each switch position.

7.06 **Subassemblies.** The test set includes subassemblies A1 through A4 and A6. A1 and A3 are identical receive circuit boards. A2 and A4 are identical transmit circuit boards. A6 contains the 1020-Hz bandpass filter and the 1020-Hz band elimination filter. All subassemblies are mounted on main circuit board A5. A1 through A4 are plug-in boards which are factory-calibrated and should not be interchanged or replaced in the field.

7.07 **VF Interface.** Sections L and R each have three mechanically-interlocked VF INTFC pushbutton switches: 2W 600 ohm, 2W 900 ohm, and 4W 600 ohm. Depressing the pushbutton applicable to the channel unit under test sets up a two-wire or four-wire interface, and coordinates test set levels and impedances with the channel unit.

7.08 The transmit amplifier on A2 and A4 has three feedback paths for setting gain, one for each VF interface. The feedback paths include the factory-calibration potentiometers. Amplifier output impedance is built out by series resistors and capacitors, which also serve as terminations at the receive amplifier input.

7.09 **Levels.** The transmit and receive attenuators are switch selectable in 0.1- dB steps between 0 and 6.3 dB. With these attenuators set at the same values as the strappable attenuators on the channel unit under test, the normal receive level indication on an external meter is 0 dBm. This applies to a two-wire channel unit or to a four-wire channel unit with tandem attenuators strapped for 0 dB loss.

7.10 The dB values marked adjacent to the XMT ATTEN and RCV ATTEN switches actually indicate decrease in loss from 6.3 dB, rather than loss. With all six switches in the 0 dB position, the attenuator loss is 6.3 dB. If the 0.4 dB switch, for example, is then set at 0.4 dB, the loss becomes 5.9 dB. However, in using the test set, it is only necessary to set the switches to agree with the channel unit strapping, without being concerned about the effect on gain or loss.

7.11 For four-wire and two-wire channel units, respectively, the nominal receive levels at the TEST connector are +7 and -3 dBm and the test set receive attenuator switch settings are 1.5 and 3 dB. (As explained in the preceding paragraph, the loss in the test set attenuator is 6.3 dB minus the switch settings; hence, the losses are 4.8 and 3.3 dB for four-wire and two-wire channel units, respectively.) To compensate for the differences in receive levels (10 dB) and receive attenuator losses (1.5 dB), an 8.5 dB pad is inserted in the measuring circuit when the 4W 600 ohm push button is depressed.

7.12 In measuring channel distortion, a meter reading is made at each of the five positions of the SEND LEVEL switch, thereby checking linearity of the channel unit CODEC. For all other test procedures, the switch is set at 0 dB.

7.13 **E&M Channel Units.** Pins 7-8 of the TEST connector on an E&M channel unit are assigned to the E lead. Inserting a cord in the T1-R1 CARR jack for VF testing grounds the E lead, but the ground is lifted when a cord is inserted in the E&M CARR jack for pulsing tests.

7.14 **Power.** Office battery is patched to the −48V IN jack and is available at the −48V OUT jack for other test equipment. The POWER indicator lights through relay K1 or K2 according to the setting of XMT-RCV switch S9. Maximum current drain of the test set itself is 70 mA.

91443 Test Patch Panel

7.15 In channel performance tests with a 91232 Test and Alignment Set, the CHANNEL UNIT connector on the 91443 panel (Figure 39) is patched to the TEST connector on the channel unit with a 12-conductor 796A Patch Cord. The VF and E&M signaling leads can then be accessed toward the drop or carrier at miniature tip-ring sleeve jacks on the 91443 panel.

7.16 The left side of the 91443-01 panel has two identical sets of jacks. This enables two channel units to be accessed at the same time for loopback testing. As an option code (Table 20), the right side of the panel can be equipped with a 24-position jack block, with or without miniature tip-ring-sleeve jacks.

7.17 The left and right sides of the 91443-02 panel have the same configuration as the left side of the -01 panel; each side has two identical sets of jacks. The option codes of the -01 panel are not applicable to the -02 panel.

91445 Signaling Path Test Set

7.18 The VF transmission and signaling/supervision (but not pulsing) over the system on any channel can be checked by replacing the channel unit at one or both banks with a 91445 Signaling Path Test Set (SPTS). Figures 40 and 41 are circuit diagrams of the 91445-01 Model 1 SPTS and the 91445-01/-02 Model 2 SPTS. Important differences are listed below.

(a) Receive signaling indicators on 91445-01 light red for busy; on 91445-02 they light green for idle.

(b) Four-wire transmit and receive pairs on Model 2 go through the VF TEST receptacle connector to the drop.

(c) A and B signaling channels on Model 2 can be independent or paralleled (strapping option).

7.19 **VF Transmission.** At the VF TEST connector, the SPTS has a balanced, four- wire, 600-ohm VF interface at fixed levels: −16.0 TLP transmit and +7.0 TLP receive. These levels are the same as on a four-wire channel unit with its step attenuators set at 1.5 dB. When a 91442 test set is used with the SPTS, the attenuator switches on the 91442 are set at 1.5 dB.

7.20 **Transmit Signaling.** The A XMT and B XMT switches control transmit signaling conditions. Up and down switch positions are busy and idle, respectively. During frames 6 through 11, transmit signaling pulse SigEnBT disables gate 2, and the inverted pulse enables gate 1. The setting of the A XMT switch appears on Sig-x as logic 1 (up) or logic 0 (down). The logic state is transmitted as bit 8 of the channel word in frame 6.

7.21 Similarly, the B XMT switch setting is transmitted as bit 8 of the channel word in frame 12. As explained in a previous discussion of channel unit timing, the coder recognizes signaling frames 6 and 12 from the pulse width of ChPT'.

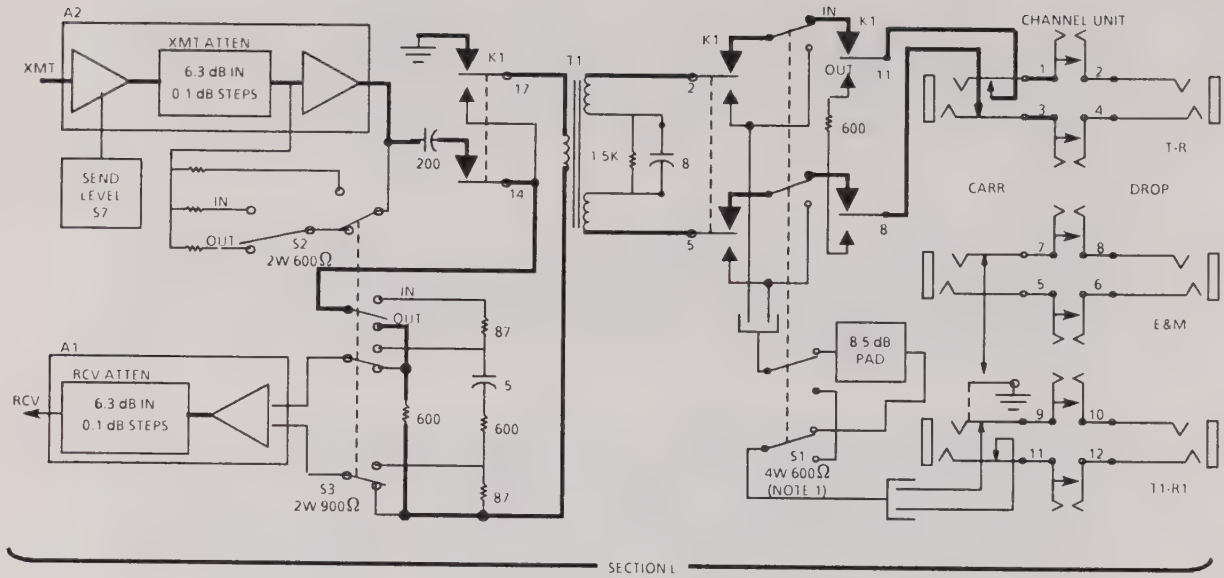
7.22 If the 91445-01 Model 1 SPTS is working end to end with a channel unit that parallels the signaling channels, the XMT switches should be operated simultaneously to the same position. The channel unit will receive opposite signaling states in alternate sixth frames. Trunk-type channel units such as 91402, 91403, 91404, and 91405 parallel the signaling channels. Special-service channel units such as 91407, 91408, and 91409 use the channels independently.

7.23 Model 2 SPTS (Figure 41) is strapped SEP (separate) for independent signaling channels. If the strapping plug is moved to COM (common) position and one XMT switch is set in the up position, the other XMT switch controls both channels. The Model 1 SPTS does not have this option.

7.24 **Receive Signaling.** In frames 6 and 12, bit 8 of the incoming channel word on Dr is latched in the decoder and then output on Sig-r at the end of the frame. The signaling state remains on Sig-r for six frames, 7-12 for the A channel and 1-6 for the B channel. At the start of frame 12, the inverted falling edge of SigEnBR' clocks FF4, latching the A signaling state in the flip- flop. At the start of frame 6, the rising edge of SigEnBR' clocks FF5, latching the B signaling state.

7.25 On the 91445-01 SPTS, if Sig-r is logic 1 (busy) when the flip-flop is clocked, the Q' output goes low and the red RCV indicator lights. On the 91445-02 SPTS, if Sig-r is logic 0 (idle) when the flip-flop is clocked, the Q output goes low and the green RCV indicator lights.

7.26 To prevent false flip-flop triggering, SigEnBR' goes through a lowpass R-C filter (100 ohms and 0.001 µF) that suppresses high-frequency spikes without degrading the clock edges.



NOTES:

1. Main Signal Paths. Heavy lines show the main signal paths with XMT-RCV switch S9 in the L-R position and VF INTFC pushbuttons S1 and S4 (4W 600Ω) depressed to "IN" position.
2. VF INTFC Pushbuttons. The three pushbuttons (S1, S2 and S3 In section L; S4, S5 and S6 in section R) are interlocked so that only one can be "IN" at the same time.
3. Resistors And Capacitors Values are in ohms and microfarads.
4. The 600 ohm resistor termination at EXT OSC was added at Issue 4.

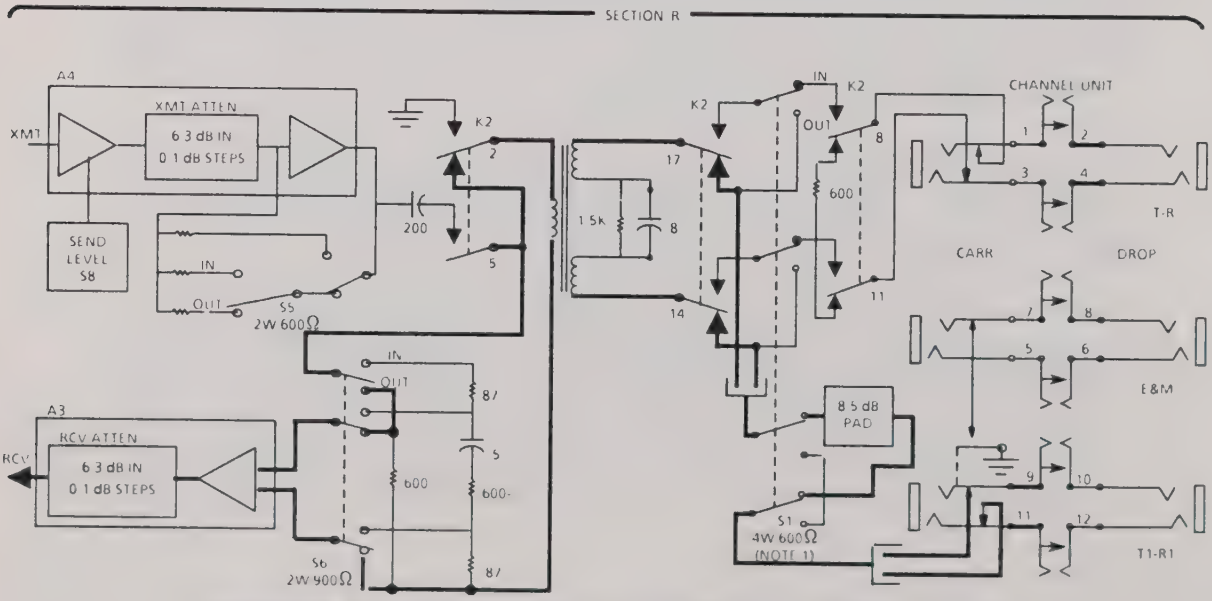


Figure 38. 91442 VF Test Set - Circuit Diagram (Sheet 1 of 2).

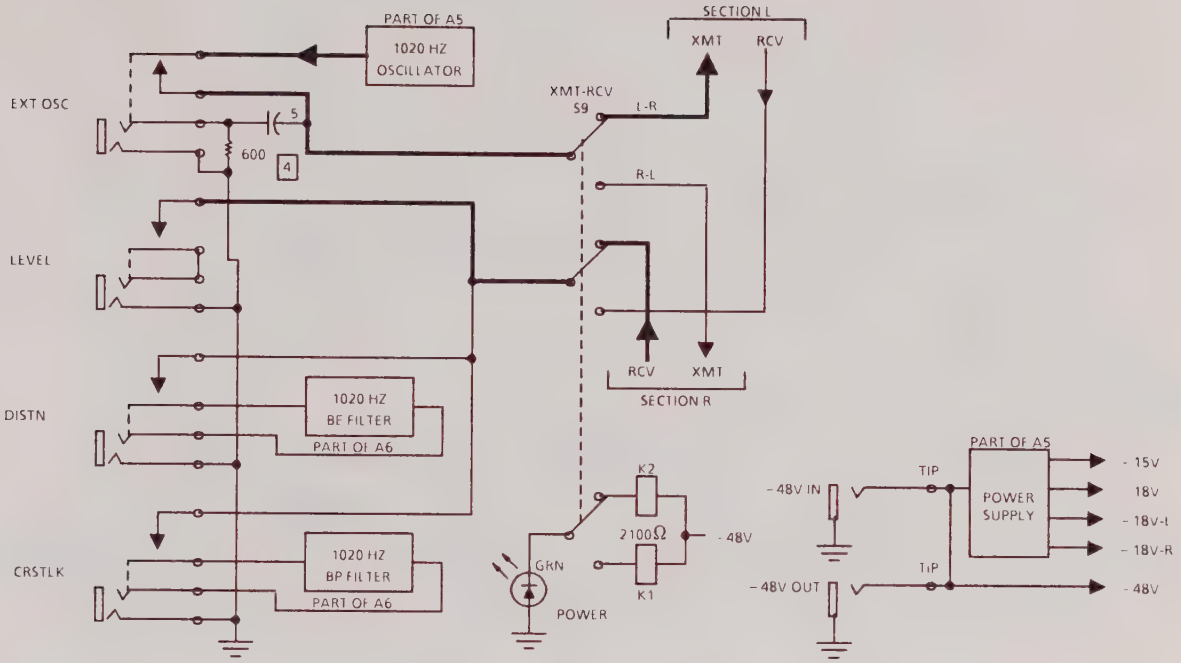


Figure 38. 91442 VF Test Set - Circuit Diagram (Sheet 2 of 2).

FIGURE 39a. BASIC CHANNEL UNIT ACCESS CIRCUIT

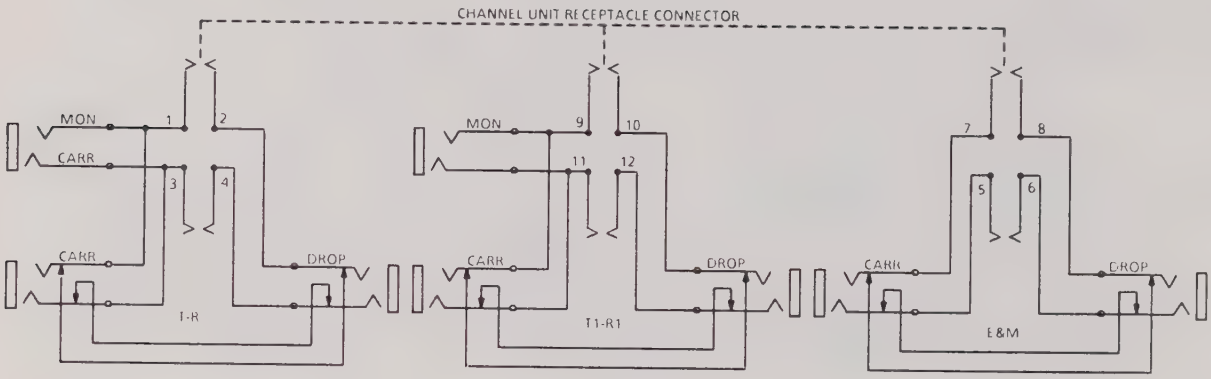


FIGURE 39b CODE DB (24 TRIPLE JACKS)

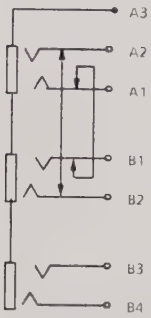


FIGURE 39c. CODE DC (24 TRIPLE JACKS)

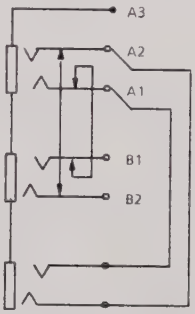
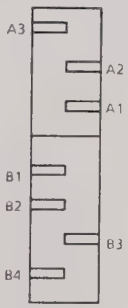


FIGURE 39d. REAR VIEW OF JACKS



NOTES:

1. 91443-01 Panel. The left side is equipped with two Figure a's. The right side may be equipped with 24 triple jacks, Code DB (Figure b) or Code DC (Figure c)
2. 91443-02 Panel. The left side and right side are each equipped with two Figure a's

Figure 39. 91443 Test Patch Panel - Circuit Diagram.

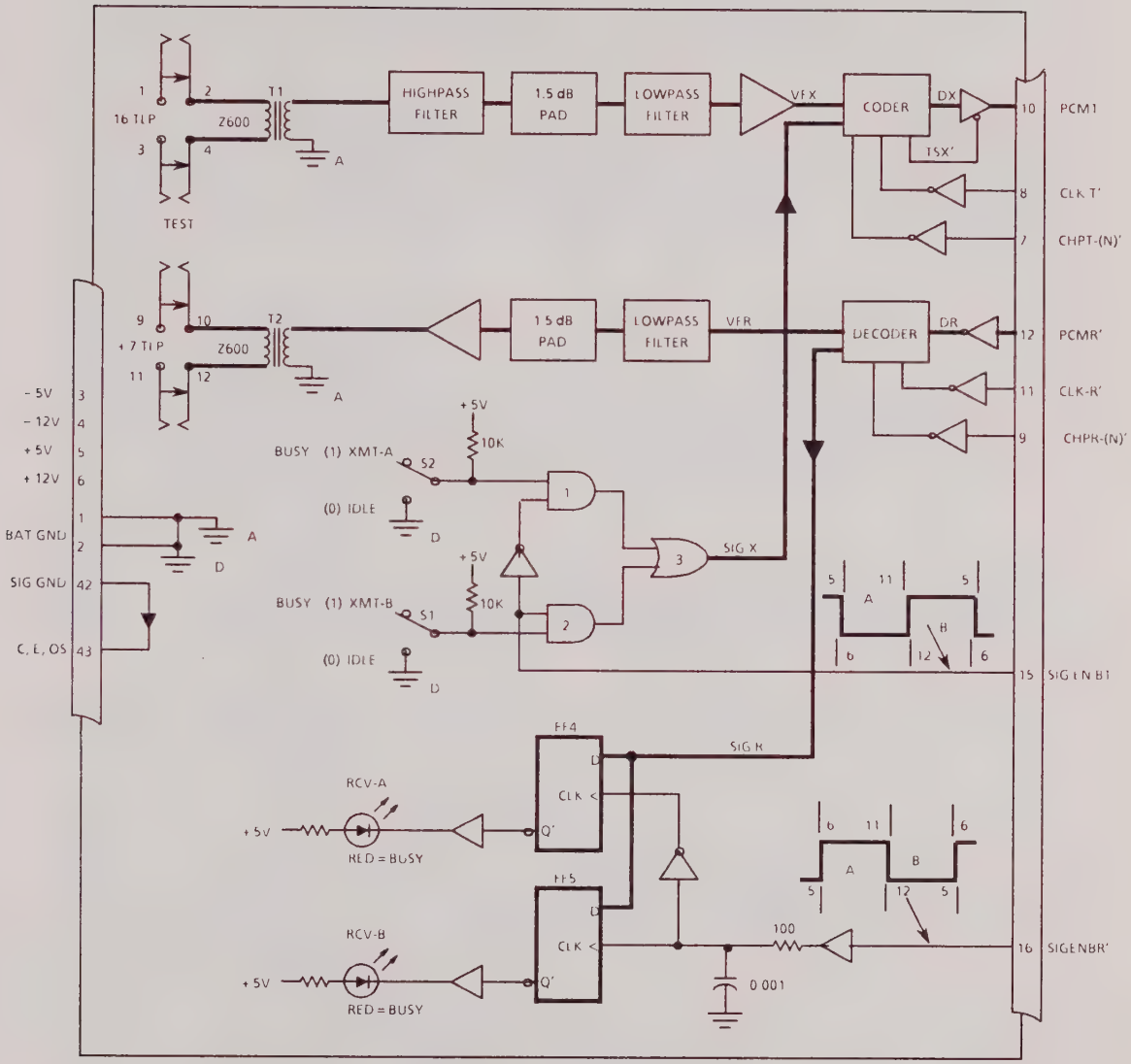
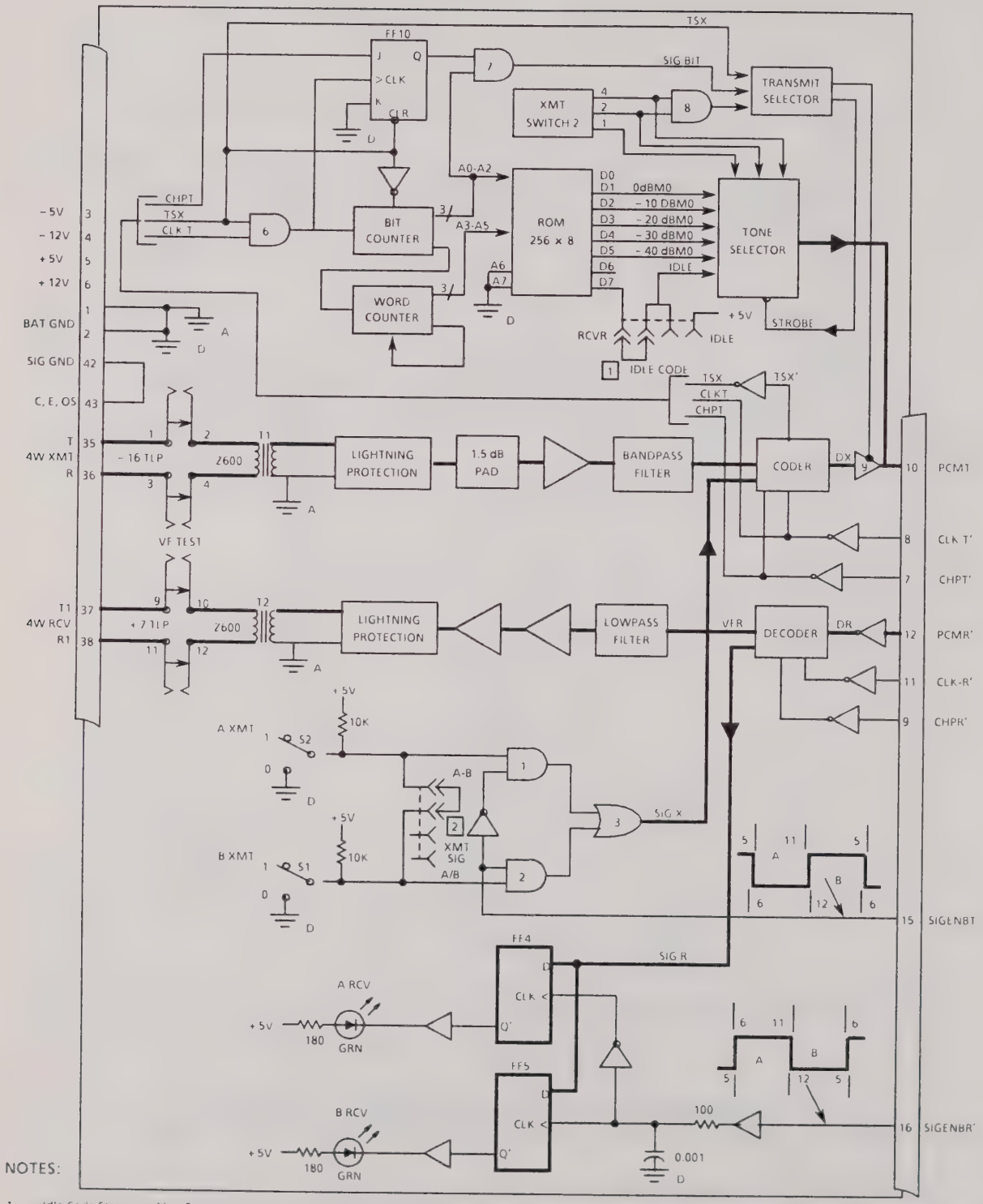


Figure 40. 91445-01 Model 1 Signaling Path Test Set - Circuit Diagram.



NOTES:

1 Idle Code Strapping Plug Options In XMT switch position 5,transmit PCM bits 2-8 (except signaling bit 8) are 1s RCVR Position Bit 1 changes state every four frames IDLE Position Bit 1 is always 1

2 XMT Sig Strapping Plug Options A/B Position. Control A and B signaling channels independently with A XMT and B XMT switches A-B Position Set B XMT switch up and control A and B signaling channels in parallel with a XMT switch

Figure 41. 91445-02 Model 2 Signaling Path Test Set - Circuit Diagram.

8. ENGINEERING CONSIDERATIONS

Equipment Location

8.01 The channel bank should be located in an area of the office that provides adequate lighting and working space. Dusty environments must be avoided. Rear access is required for installation and maintenance.

8.02 The channel bank must not be mounted near sources of excessive heat such as furnace outlets, or above heat-producing units such as power supplies and tube- type equipment. The ambient temperature range and maximum relative humidity are specified in the Technical Summary.

8.03 To prevent heat buildup, a one-space ventilation baffle (Code AA of the 91430 shelf) installed directly above the channel bank is recommended. This is particularly important if the bank is equipped with Dial-Pulse Originating (DPO) or Foreign-Exchange Subscriber (FXS) channel units. Because of loop current, which is inversely proportional to loop length, heat dissipation is greater in DPO and FXS channel units than in other types.

NOTE: The baffle must be mounted on the rack so that it slopes up from the rear, directing the rising heated air out the grill at the front. Air flow into the equipment above enters at the rear of the baffle.

8.04 The ventilation baffle may be omitted under any of the following circumstances:

(a) Channel units are E&M types.

(b) The channel bank is in an air conditioned electronic office.

(c) Other equipment below the channel bank breaks up the vertical heat rise.

NOTE: If a ventilation baffle is not used, the 91430 shelf must be equipped with a top plate, Code AB.

8.05 Install the channel bank at least 6 feet away from strong magnetic fields and sources of switching impulse noise that might be coupled into the channel bank circuits.

Power Requirements

8.06 Channel bank DC power is obtained from the 48-volt office battery. Four lower voltages (+5V, −5V, +12V, and −12V) are derived from −48V by the 91425 Power Supply Unit and distributed to the common equipment units and channel units. Some units also use −48 volts directly as signaling battery or talking battery.

8.07 The 91436 Power Distribution Unit (PDU) supplies fuse-protected, filtered talking battery and 20-Hz ringing voltage, when required, via A and B distribution circuits to the two digroups. As shown in Figure 14, TB1-3 is strapped to TB1-4 and unfiltered office battery is routed through the PDU to the channel units. If talking battery is available, the battery may be connected to TB1-4 and the strap to TB1-3 removed.

Alarms

8.08 The channel bank has power, local, remote, system, and fuse alarm indicators. Each 91420 Alarm Control Unit has a system alarm relay with three sets of form-C contacts for controlling office audible and visual alarms, and an electronic office alarm (EAX alarm). The contact rating for noninductive loads is 1 ampere at 48 Vdc.

8.09 The 91436 Power Distribution Unit provides a separate fuse alarm relay with one set of form A contacts. Maximum contact ratings are 2 amperes, 220 volts, and 100 volt-amperes.

8.10 To increase contact life and, more important, to suppress electrical noise, a contact protection network is required for an inductive load current over 10 mA or a load inductance greater than 0.5 henry. Protection networks should be installed as close as possible to the inductive load.

8.11 If a system alarm peg count is desired, the 91420-02 Alarm Control Unit has a three-digit electromechanical register.

Supervisory System

8.12 **91419 Remote Performance Interface Unit (RPIU).** The RPIU provides two ports (RS-232-C and RS-422) for connection to a CRT or supervisory systems, respectively. The RS-232-C port has a proprietary command interface and the RS-422 has a TBOS protocol.

8.13 **91448 Office Interface Unit (OIU).** The OIU provides six alarm outputs to an external supervisory system and four control inputs (Figures 20 and 36). Inputs and outputs are as follows:

(a) Alarm outputs: Local alarm and remote alarm in each digroup, power alarm, and loop-relay-operated indication. The output drivers are open-collector transistors. In an alarm condition, the transistor turns on and can source up to 20 mA from ground to a negative voltage in the supervisory system.

(b) Control inputs: Alarm cutoff relay and loop relay in each digroup. The inputs are normally open (resistance to ground greater than 30k ohms) in the supervisory system. They are activated by a resistance to ground less than 20.2 k/ohms.

Cable Equalizers

8.14 The bipolar digital line signals of the 9004B channel bank are designated DS1C in Mode 1 and Mode 2, and DS1 in Mode 3. At the standard cross-connect points, designated DSX-1C and DSX-1, the nominal signal level is 3 volts, base-to-peak. Digital signal cross-connects are described in Section 836-910-070.

8.15 The distance between the equipment and the DSX frame determines which one of five equalizers is required. The equalizer, in the transmit signal path just preceding the digital line connection, is the same for DS1 or DS1C signals. For Mode 1 or 2, the single equalizer plugs into J65 at the rear of the shelf; for Mode 3, the two equalizers plug into J65 (digroup A) and J75 (digroup B).

NOTE: When the 91418 TREU is equipped, no cable equalizer is required for that digroup. Information on installation of a bypass strap and TREU equalizer settings are contained in Section 342-911-134.

8.16 As shipped from the factory, the channel bank is equipped with two cable equalizers (pn 087-54460-01) that work with up to 133 feet of GTS-8510 or ABAM cable. For longer cable lengths up to 655 feet, order the applicable equalizer listed in Table 12 (code DB, DC, DD, or DE), one for Mode 1 or 2 and two for Mode 3.

Office Wiring

8.17 External connections and strapping on the 91430 shelf are illustrated and described in Section 342-911-134. Some additional information for installation planning is given below.

8.18 **Power.** The channel bank has its own primary DC power fuse allowing office battery to be run directly to the 91430 shelf. This eliminates the need for a fuse panel in the bay. Office battery, rack ground, and a 20-Hz ringing supply, if required, are wired to No. 5 screw terminals on barrier terminal board TB1. Alternatives to this arrangement are as follows:

(a) If separate battery ground and rack ground connections are required (in an electronic office, for example), remove the strap between TB1-1 and -2 and connect the battery ground lead to TB1-2.

(b) If a separate talking battery supply to the channel bank is provided, remove the strap between TB1-3 and -4 and connect the battery lead to TB1-4.

8.19 Wiring should be adequate to maintain at least 44 volts at the channel bank under conditions of maximum load and minimum office battery voltage. Wire sizes can be calculated according to the criteria presented in Section 795-001-070, with consideration that a channel bank could have a worst-case load up to 6.5 amperes. A 7-1/2 ampere fuse is recommended.

8.20 Office battery ground leads, minimum 6 AWG, must be capable of handling currents up to 6.5 amperes per channel bank. The ground lead usually is terminated at a solderless connector attached to the equipment rack at the top. A ground wire, minimum of 6 AWG, is from terminal board TB1 of each 91430 shelf to the equipment rack in accordance with Section 795-805-073.

Table 12. Digital Cable Equalizers and Cable Lengths.

Cable Equalizer		Length of 22-Gauge Cable to DSX-1 or DSX-1C Cross-Connect	
Part Number	91430 Shelf Option Code	General Cable 4162	General Cable 4503
		Feet	Feet
087-54460-01		0 to 110	0 to 133
-02	DB	110 to 222	133 to 267
-03	DC	222 to 332	267 to 400
-04	DD	332 to 442	400 to 533
-05	DE	442 to 544	533 to 655

NOTE: Cable equalizers are not required when the 91418 TREU is equipped.

8.21 **System Alarm.** Three form-C contacts of the system alarm relay in the 91420 Alarm Control Unit appear on receptacle connectors J63 (unit A) and J73 (unit B). If the rack assembly has a 91455 Fuse and Alarm Panel, the system alarm circuits of all channel banks on the rack can be extended to and consolidated on the 91455 panel via wiring harness 088-91006-xx described in Table 17. These harnesses have 10-pin connectors that plug onto wirewrap terminals on J63 and J73 of up to six channel banks in the standard configurations of Figure 43. Refer to the 91455 panel circuit diagram in Section 342-911-134.

NOTE: Wirewrapping to the 0.025-inch square terminals on J63 and J73 in the field is not recommended. For nonstandard rack configurations, wiring harness 088-91066-05 or -06, 12 feet long, can be used to access the alarm circuits of one (-05) or both (-06) 91420 units. (The restriction against wirewrapping applies to J62 also; see next paragraph.)

8.22 **Composite Clock.** Wiring harnesses 088-91006-xx include a single pair multipled between three-pin connectors that plug onto wirewrap terminals on J62, the 91419 Remote Performance Interface Unit (RPIU) or 91448 Office Interface Unit (OIU) receptacle connector. The 91455 Fuse and Alarm Panel has a 121-ohm resistor at TB3-8A and -9A to terminate this composite clock distribution circuit. Composite clock, which is required for certain digital data applications, may originate in the RPIU or OIU, or may be obtained from the office equipment.

8.23 **Supervisory System.** An external supervisory system, when used, connects to the channel bank at J62, the OIU or RPIU receptacle connector. Wire wrapping to the terminals is not recommended. A locally-fabricated wiring harness with four connectors plug onto the wirewrap terminals of J62 is recommended. The connectors are assembled from the parts listed below in accordance with the wiring diagram and instructions in Section 342-911-134.

(a) Connector body, three contact position; Siemens Communication Systems pn 140- 54174-04 (Molex pn 09-50-7031); 2 required.

(b) Connector body, four contact positions; Siemens Communication Systems pn 140-54174- 03 (Molex pn 09-50-7041); 2 required.

(c) Contact, electrical, 24- or 26-AWG wire; Siemens Communication Systems pn 140- 54175-01 (Molex pn 08-56-0108); 10 required.

8.24 A crimping tool, Molex pn HTR-2445A, is recommended for attaching wires to the contacts. If the tool is not available, crimping can be done with needle-nose pliers.

8.25 **Fuse Alarm.** The form A contacts of the fuse alarm relay in the 91436 Power Distribution Unit appear on receptacle connector J50. Wirewrap terminals on J50 are 0.032 x 0.062 inch.

8.26 **Digital Lines.** The transmit and receive DS1 or DS1C signals of the 9004B channel banks may be cabled in the same multipair shielded cable. Separation of the digital cabling and VF cabling is not necessary from an electrical standpoint but is recommended for physical protection of the pairs. Shielded cable should not be laced to the cable rack or cable rings. If lacing is necessary, the stitches should be loosely tied so that indentations are not made in the cable. Tight stitching could deform the cable sufficiently to change its electrical characteristics and, in extreme cases, might cause a shield-to-conductor short. When cable ties are used to secure cables to hexagonal studs, the studs must be insulated to prevent possible short circuits.

8.27 To prevent ground loops, DS1 and DS1C cable shields are usually grounded at the channel bank end only. Under special circumstances, field experience may indicate a need to ground the shield at both ends of the cable. Shield connections should be routed to the office ground in as short a distance as possible.

8.28 This publication refers to two types of shielded cable for DS1 and DS1C signals:

(a) AT&T ABAM multipair cable having unshielded 22-gauge pairs within a common shield; manufactured by General Cable Corp as type 4155. Because of its smaller diameter, this cable is preferred to GTS-8507.

(b) High-frequency terminating cable with 1, 5, 8, 10, or 12 individually shielded 22-gauge pairs; manufactured by General Cable Corp as type 4162.

NOTE: Maximum cable lengths are included in Table 12. Siemens Communication Systems stock numbers and other identifying numbers for GTS-8507 and GTS-8510 cables are listed in Tables 13 and 14.

8.29 Transmit and receive digital lines terminate on 0.045-inch square wirewrap terminals on J66 (DS1C or DS1 digroup A) and J76 (DS1 digroup B) at the rear of the shelf. As an alternative to wirewrapping, the lines can be terminated in two connectors that mate with the wirewrap terminals. The connectors are assembled from the parts listed below in accordance with the wiring diagram and instructions in Section 342-911-134.

(a) Connector body, six contact positions; Siemens Communication Systems pn 140-54174-08 (Molex pn 09-50-7061); 2 required.

(b) Contact, electrical, 18- to 22-AWG wire; Siemens Communication Systems pn 140-54175-02 (Molex pn 08-56-0106); 10 required. See paragraph 8.25.

(c) Polarizing key; Siemens Communication Systems pn 140-54174-10 (Molex pn 15-04-0219); 2 required.

Table 13. Identifying Numbers for 22 gauge Unit-Shielded Cable.

Number of Pairs	General Cable
12	4503 22/12
26	4503 22/20
51	4503 22/51
101	4503 22/101

Table 14. Identifying Numbers for 22 gauge Individually Shielded Cable.

Number of Pairs	General Cable
1	4162A
5	4162B
8	4162C
10	4162D
12	4162E

8.30 **VF and Signaling/Supervisory Circuits.** Four pin-pairs on the channel units are preassigned to VF and signaling/supervisory circuits; for example, pins 35 and 36 are the T and R leads of a four-wire VF transmit circuit. The four pin- pairs are factory wired to 50-pin male receptacle connectors J101 through J104 and J201 through J204. Each connector accommodates one pin-pair from the 24 channels of one digroup; for example, pins 35/36 of channels 1A through 24A are wired to J102. The pin-pair assignments and typical wiring to the 50-pin receptacle connector are shown on Figure 16.

8.31 The mating 50-pin female plug connector, with solder-type or crimp-type wire terminals, is identified by one of the following part numbers:

Terminals	Siemens Communication Systems	AT&T
Solder-type, max 22 AWG solid wire	140-54655-02	KS-16690L-01
Crimp-type, max 24 AWG solid wire	140-54655-04 (Amphenol) 140-56620-01 (AMP)	KS-16690L-12

8.32 Cable assemblies, up to 300 feet, for extending channel circuits to the office equipment are available (Table 17). Channel circuits can be routed through the connectorized versions of the 5215B Miniature Jackfield Assembly (Section 342-521-100). Interconnections are made with the cable assemblies cited above and with connectorized terminal block 163-10352-xx. See Figure 42.

8.33 **VF and Signaling Circuits, 91430-11 Shelf.** On the 91430-11 shelf, pins 33/34 on the channel units are wired to two additional 50-pin male connectors, J105 and J205 for digroups A and B, respectively. Pins 33/34 are assigned to the BSY-1/SYN leads of the 91450 Stop Dial/Wink Originating Channel Unit. Also, pin 34 is assigned to an optional PC lead on the 91403-11 SDPO Channel Unit.

8.34 VF connections to the 91430-11 shelf are made with ten 50-pin super ribbon connectors, made by TRW-Cinch. These connectors have a spring clip at each end that snaps into a window in the mating super ribbon female connector. The super ribbon connectors on the shelf will also accept the metal-shell female connectors listed in paragraph 8.31 and used on the 163-10315-XX and 163-10316-XX cable assemblies.

FIGURE 42a. 163-10352-13 OR -14 TERMINAL BLOCKS WIREWRAP AND TERMINAL ASSIGNMENTS

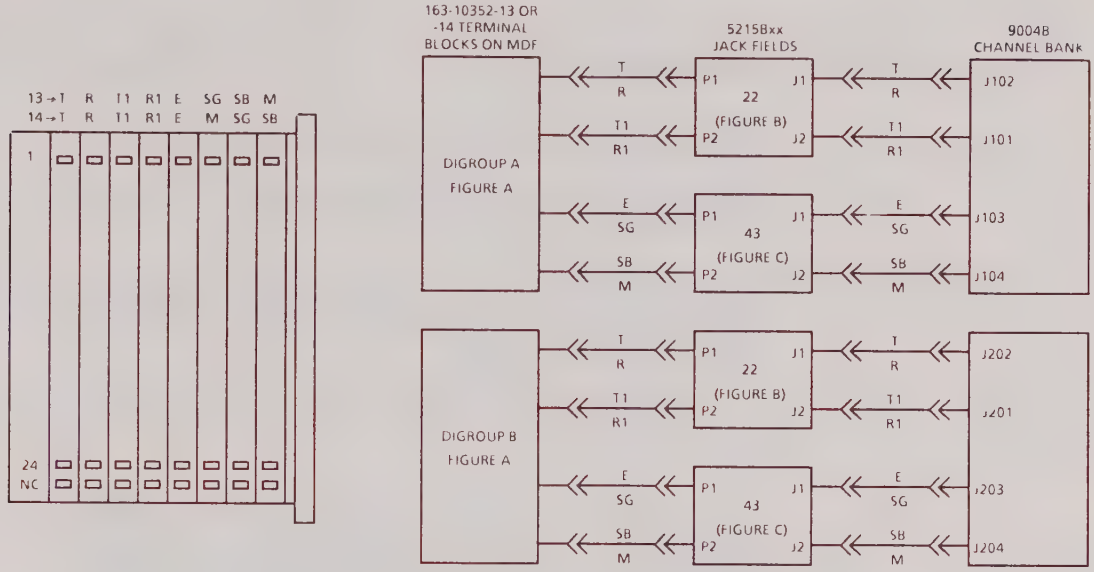


FIGURE 42b. FOUR-WIRE VF JACKS FOR24 CHANNELS (52158-22)

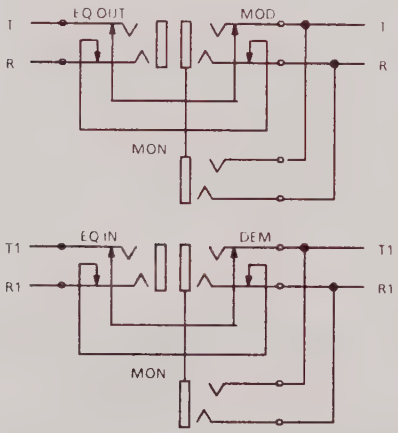
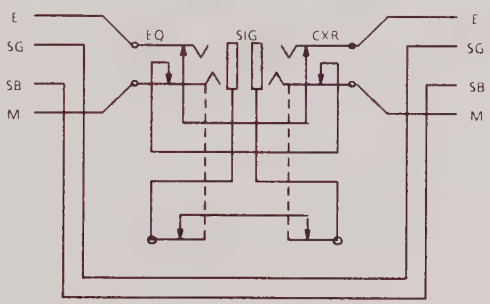


FIGURE 42c. E&M SIGNALING JACKS FOR 24 CHANNELS; TYPE I, II, OR III INTERFACE (52158-43)



NOTE: On the 91402 2W E&M Channel Unit, A/B leads replace T/R leads at J101 and J202.

LEGEND

CABLE ASSEMBLY 163-10316-XX

Figure 42. Cabling from 9004B Channel Bank to 5215B Jackfield and MDF.

9. EQUIPMENT IDENTIFICATION

9.01 Components of the 9004B PCM Channel Bank and associated equipment are identified and described in Tables 15 through 20 as follows:

Table	Description
15	Channel bank shelf and common equipment units.
16	Channel units; refer to the Sections listed in Table 2 for additional information.
17	Channel units with test access through telephone-type jacks; refer to the Sections listed in Table 2 for additional information.
18	Ancillary equipment, used with but not part of the 9004B.
19	Recommended test equipment. The equipment listed does not indicate a preference; equivalent items by other manufacturers may be substituted. Type numbers and model numbers are the latest available as of the publication date. Check with the manufacturer before ordering.
20	Fuses.

9.02 For standard configurations of the channel bank and standard rack assemblies, see Part 10.

Table 15. List of Common Equipment (Sheet 1 of 3).

Type No.	Name	Qty per Shelf M1 M2 M3	Description
91430-xx	Terminal Equipment Shelf		Supports and interconnects 10 common equipment units and 48 channel units; includes two cable equalizers, 087-54460-01. -01 Has eight 50-pin connectors, four per digroup for drop interface with channel unit VF and signaling/supervisory circuits. -11 Same as -01 except with ten 50-pin connectors, five per digroup; required only for 91450 Stop Dial/Wink Originating Channel Units. NOTE: Heat dissipation requirements dictate that the shelf be equipped with a top plate (Code AB) when a ventilation baffle (Code AA) is not installed directly above the shelf on the rack. AA Ventilation baffle 024-56830-01 and mounting hardware; one rack mounting space. AB Top plate 020-56735-01 and mounting hardware. BA Channel assignment label 123-91400-02 and bracket 020-56730-01; for a front-mounted shelf applications; bracket attaches to shelf side plate. BB Channel assignment label 123-91400-02, bracket 020-56937-01, and mounting hardware; for a rear-mounted shelf on an unequal-flange duct type rack; bracket attaches to front of rack. DB thru DE digital cable equalizers; see Table 12.
91418-01	Transmit and Receive ESF Unit (Note 1)	- - 2	-01 The transmit portion combines the PCM words from 24 channels plus framing bits into a bipolar DS1 line format. In the receive portion, demultiplexes the bipolar DS1 signal to recover the digital VF and signaling for 24 channels. Provides B8ZS or AMI line codes, SF or ESF formats , using D3/D4 channel sequencing. ESF provides a 4-kb/s facility data link for extensive monitoring of signal quality.

Table 15. List of Common Equipment (Sheet 2 of 3).

Type No.	Name	Qty per Shelf M1	M2	M3	Description
91419-02	Remote Performance Interface Unit	-	-	1	Provides extensive performance monitoring of the 9004B DS1 spans and gathers alarm related information. Provides local or remote access via RS-232-C and/or RS-422 serial interfaces to the TREU for querying, alarm reporting, and programming the system. Unit supplies 64-kHz bit sync and 8-kHz byte sync signals to data channel units. These signals are derived from a 64-kHz composite clock, which may be an input or output as a strapping or a programmable option. With the input option, the composite clock synchronizes generation of a 1.544-MHz supplied to the 91418 TREU. With the output option, a composite clock is generated and synchronized with receive timing in either digroup.
91420-xx	Alarm Control Unit (note 1)	1	2	2	-01 Monitors channel bank status and provides visual alarm indications and system alarm relay contacts for office alarms. -02 Same as -01 except also equipped with a resetable three-digit system alarm peg count register
91425-01	Power Supply Unit	1	1	1	From a -48 volt DC input, supplies regulated DC voltages to units of the 91430-01 shelf. Voltages and maximum loads are: +5V at 3.7A, -5V at 0.45A, +12V at 0.9A, and -12V at 1.1A.
91426-01	Syndes Unit (Model 2)	-	1	-	Synchronizes and combines transmit signals of digroups A and B plus control bits into an M1C- compatible DS1C line signal; performs a reciprocal function in the receive direction. (91426-01 model 1 cannot be used.)
91427-01	Line Interface Unit	1	-	-	Combines transmit signals of digroups A and B plus F-bits into a DS1C line signal (not M1C compatible); retimes and descrambles the incoming DS1C line signal.

Table 15. List of Common Equipment (Sheet 3 of 3).

Type No.	Name	Qty per Shelf M1	M2	M3	Description
91436-01	Power Distribution Unit	1	1	1	Distributes office battery, talk battery, and 20-Hz ringing voltage through eight fuses to channel bank plug-ins; has filters for talking battery and fuse alarm relay for office alarms.
91438-01	Transmit Unit (Note 1)	2	2	2	Combines the eight-bit PCM words from 24 channels plus framing bits into a unipolar output signal to the line interface unit (Mode 1) or syndes unit (Mode 2). In Mode 3, the output is a bipolar DS1 line signal
91439-01	Receive Unit (Note 1)	2	2	2	Demultiplexes the unipolar signal from the line interface unit (Mode 1) or syndes unit (Mode 2) or the bipolar DS1 line signal (Mode 3) to recover the digital vf and signaling information for 24 channels.
91448-xx	Office Interface Unit	1	1	1	-01 Extends alarm and control leads to a (optional) supervisory and control system. -02 Same as -01, plus supplies 64-kHz bit sync and 8-kHz byte sync signals to data channel units. These signals are derived from a 64-kHz composite clock, which may be an input or output as a strapping option. With the input option, the composite clock synchronizes generation of a 1.544-MHz or 3.152-MHz clock supplied to the transmit units or line interface unit. With the output option, a composite clock is generated and synchronized with receive timing in either digroup.

Note: Mode 3 with One Digroup. The transmit and receive units or the transmit and receive ESF unit, and the alarm and control unit of the unused digroup are not required. To prevent misleading indications, if the units are ordered, they should not be plugged into the shelf. This is particularly applicable to the alarm and control unit.

Table 16. List of Channel Units with Paddle Jacks (Sheet 1 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Features and Codes	Signaling and Supervisory Strapping Options
			Transmit	Receive		
E&M	91402-xx Two-Wire E&M (Model 2)	-01: 900 + 2.15 µF -02: 600 + 2.15 µF	4.5 to + 1.8 dBm	0 to -6.3 dBm	C1 lead (Code A, 087-56916-01) NBOC (Note 1) A and B leads, 80 mA	Signaling interface: Sig Lead Intfc Type On hook/Off hook Receive I, III Std Open/ground I PLR Ground/battery II Open/closed Transmit I, III Std Ground/batter I PLR Open/ground II Open/battery
	91404-01 Four-Wire E&M (Model 2)	600	-17.5 to 11.2 dBm (Note 2)	+8.5 to + 2.2 dBm (Note 2)	C1 lead (Code A, 087-56916-01)	E lead during system alarm: On-hook Off-hook On-hook 2 seconds, then off-hook NORM/BUSY switch in BUSY: Local busy Remote busy Local and remote bus Signaling battery source: Internal External via F lead Midpoint capacitor for A and B leads (91402-xx): Internal External
Loop	91403-xx Dial Pulse Originating (DPO)	900 + 2.15 µF	-4.5 to + 1.8 dBm	0 to -6.3 dBm	-02: Equipped with HS Test Jack 1800- ohm loop NBOC (Note 1) CPFR	C lead busied by: Transmit off-hook Transmit or receive off-hook SxS selector: Open-seeking Battery-seeking Control/alarm leads: C OS or S B1-B2 ATB lead and: EC lead Peg-count lead, 100-ms ground pulse CPFR: With delay-dial or wink supervision With answer supervision No CPFR Battery at two-wire port: Normal battery in alarm Delayed (2 s) reverse battery in alarm Nonreversing battery

Table 16. List of Channel Units with Paddle Jacks (Sheet 2 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Features and Codes	Signaling and Supervisory Strapping Options
			Transmit	Receive		
Loop	91405-01 Dial Pulse Terminating (DPT)	900 + 2.15 µF	4.5 to +1.8 dBm	0 to 6.3 dBm	Pulse corrector (Code A ,087-56911-01) C lead NBOC (Note 1) Seize 900-ohm loop, Pulse 200-ohm loop	Off-hook wink is transmitted as a signaling integrity check when C lead is closed to ground externally after seizure. Reverse-to-normal transition on two-wire drop produces an extended guard delay of 40 or 200 ms; with Code A, the delay is 600 ms
No sig	91401-01 Four-Wire (Model 2)	600	-17.5 to -11.2 dBm (Note 2)	+8.5 to +2.2 dBm (Note 2)		
FX	91407-01 Four-Wire Tandem	600	-17.5 to -11.2 dBm (Note 2)	+8.5 to +2.2 dBm (Note 2)	Eight-wire interface; electronic signaling leads E1, E2, M1, and M2 (Note 4)	
	91408-02 Foreign Exchange Office (FXO)	600 or 900 + 2.15 µF	-10.9 to +1.8 dBm	+2.0 to -10.7 dBm	NBOC (Note 1) Pulse corrector (Code A ,087-57028-01); not on model 1 Balance network (Note 3) Seize 1300-ohm loop pulse 800-ohm loop	Signaling mode: Loop start Ground start Signaling format: No. 3 EAX interface D3/D4 and D1D Trunk-make-busy: Idle; with or without C lead Idle 2 seconds, then busy; with or without C lead
	91409-01 Foreign Exchange Subscriber (FXS)	600 or 900 + 2.15 µF	-10.9 to +1.8 dBm	+2.0 to -10.7 dBm	NBOC (Note 1) Balance network (Note 3) 1800-ohm loop	Signaling mode: Loop start Ground start Signaling format: No. 3 EAX interface D3/D4 and D1D Trunk-make-busy: Idle; ringing inhibited Idle 2 seconds, then busy

Table 16 List of Channel Units with Paddle Jacks (Sheet 3 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Features and Codes	Signaling and Supervisory Strapping Options
			Transmit	Receive		
TSPS	91411-01 Four-Wire Loop Simplex Originating	600	-4.5 to +1.8 dBm	-1.5 to -7.8 dBm	For TSPS service	TMB Normal battery Reverse battery if loop is open; if loop is closed, normal battery to stop charges, then reverse battery 200 ms after loop is opened

Notes:

1. NBO Capacitance. NBOC is strappable from 0 to 0.126 µF in 0.002-µF steps

2. Four-Wire VF Drop Levels. Transmit and receive levels shown for the 91401, 91404, and 91407 channel units are for nontandem applications with the TANDEM attenuators strapped for 0 dB. Level ranges for all settings of the TANDEM attenuators are listed in Table 6.

3. Balance Networks. Optional hybrid balance networks for the 91408, 91409, 91470, and 91471 channel units are listed below:

Code	Cable Loading and Gauge
AA	H88 loading; 19 or 22 AWG
AB	H88 loading; 24 or 26 AWG
AC	D66 loading; 19 or 22 AWG
AD	Non-loaded cable

4. Tandem Channel Unit. The 91407-01 cannot be used on a channel that terminates in a subscriber-type channel unit of the 9002A/B channel bank. The ringing signal to the subscriber, which is transmitted via the voice path, would be blocked by the 180-3400 Hz passband of the 91407-01

Table 16. List of Channel Units with Paddle Jacks (Sheet 4 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Features and Codes	Signaling and Supervisory Strapping Options
			Transmit	Receive		
Special purpose	91434-01 Four-Wire SF	600	+5.5 to +7 dBm	-14.5 to -16 dBm	Pulse correction Microprocessor signaling control	SF signaling: Normal Disabled for CCIS FDM TMB: On-hook On-hook, then off-hook 60 or 90 ms after PCM RCV goes on-hook PCM TMB: On-hook On-hook, then off-hook 60 or 90 ms after FDM RCV goes on-hook NORM/BUSY switch in BUSY: Local busy Remote busy Local and remote busy
	91470-xx DPO/ICT	900 + 2.15 µF	-10.9 to +1.8 dBm	+2 to -10.7 dBm	CPFR For service with GTD-5 or GTD-3 EAX Loop length (ohms) -01: 200 to 2000 -02: 1800 to 3000 NBOC (Note 1) Balance network (Note 3)	TMB Normal battery Delayed (2 s) reverse battery
	91471-01 DPT/OGT	900 + 2.15 µF	-10.9 to +1.8 dBm	+2 to -10.7 dBm	For service with GTD-5 or GTD-3 EAX Pulse corrector (Code A, 087-56911-01) NBOC (Note 1) Balance network (Note 3)	Pulsing: Normal battery Delayed (2 s) reverse battery

Table 17. List of Channel Units with Test Access Through Miniature Telephone-Type Jacks (Sheet 1 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Codes and Features	Strapping Options
			Transmit	Receive		
E&M	91452-xx Two-Wire E&M	-11: 900 + 2.15 uF -12: 600 + 2.15 uF	– 10.9 to + 1.8 dBm	+ 2.0 to – 10.7 dBm	C1 lead, Code C, 087-56916-01 Precision networks (Note 2) NBOC (Note 1) A and B leads, 80 mA See Note 4	Signaling interface: Sig Lead / Intfc Type / On-hook/Off-hook Receive: I, III, V — Open/ground; II, IV — Open/closed; I PLR — Ground/battery Transmit: I, III — Ground/battery; II — Open/battery; IV, V — Open/ground; I PLR — Open/ground E lead during system alarm: On-hook; Off-hook; On-hook 2 seconds, then off-hook NORM/BUSY switch in BUSY: Local busy; Remote busy; Local and remote busy Signaling battery source: Internal; External via F lead Midpoint capacitor for A and B leads (91452-xx): Internal
	91454-11 Four-Wire E&M	600	– 17.5 to + 8.0 dBm	+ 8.5 to – 17.0 dBm	C1 lead, Code C, 087-56916-01 Sealing current generator, Code D, 087-54291-01	
Loop	91403-xx Sleeve Dial Pulse Originating (SDPO)	900 + 2.15 µF	– 4.5 to + 1.8 dBm	0 to – 6.3 dBm	-01: Without HS Test Jack -02: With HS Test Jack Loop seizure: 2500 ohm Max NBOC, Code B, 087-54296-01 (Note 1) CPFR	C lead busied by: Transmit off-hook; Transmit or receive off-hook SxS selector: Open-seeking; Battery-seeking Control/alarm leads: C; OS or S; B1-B2 ATB lead and: EC lead; Peg-count lead, 100-ms ground pulse CPFR: With delay-dial or wink supervision; With answer supervision; No CPFR Battery at two-wire port: Normal or reverse in idle; Normal or delayed (2 s) reverse in alarm; Nonreversing
	91405-11 Dial Pulse Terminating (DPT)	900 + 2.15 µF	– 4.5 to + 1.8 dBm	0 to – 6.3 dBm	Pulse corrector, Code A, 087-56911-01 NBOC, Code B, 087-54296-01 (Note 1) C-lead Reverse battery detection: 3000 ohm Max	200-ms off-hook wink is transmitted as a signaling integrity check when C lead is closed to ground externally after seizure. Guard delay for battery polarity transitions on the two-wire drop is 40 ms. For reverse-to-normal transitions, the delay can be extended to 200 ms (600 ms with Code A)

Table 17. List of Channel Units with Test Access Through Miniature Telephone-Type Jacks (Sheet 2 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Codes and Features	Strapping Options
			Transmit	Receive		
Special purpose	91450-11 Stop Dial/ Wink Originating	900 + 2.15 µF	– 4.5 to + 1.8 dBm	0 to – 6.3 dBm	NBOC, Code B, 087-54296-01 (Note 1) CPFR 1800Ω Loop Requires 91430-11 shelf	Channel unit access from: Four-wire selector Ticketer tied directly (53M SATT) No. 2 EAX loop trunk circuit CPFR: 160-ms delay (for CAMA) 10-s delay CPFR disabled Delay dial or wink start supervision Battery- or open-seeking selectors C-lead grounding delay: 12 or 50 ms Dial or multifrequency pulsing
FX	91407-12 Four-wire Tandem	600	– 3.6 to – 2.1 dBm	– 2.1 dBm	Electronic signaling leads: EX and EX1 transmit E and E1 receive Six-wire interface; EX1 and E1 are simplexed on the VF pairs See Note 3	Three-state or two-state signaling Looped or nonlooped signaling leads E lead (pin 43) during system alarm: Open Open 2.5 seconds, then ground
	91434-12 Four-Wire SF/FX	150,600, 1200	– 17.5 to + 8 0 dBm	– 17.0 to + 8.5 dBm	Reversed XMT & RCV functions Sealing Current Code D, 087-54291-03	Four-wire impedance: 150, 600 or 1,200 SF Signaling modes: E&M Loop start - FXO (PCM to subscriber) FXS (PCM to office) Ground start- FXO (PCM to subscriber) FXS (PCM to office)
	91458-11 Foreign Exchange Office (FXO)	-11:600 or 900 + 2.15 µF -12: 600 or 900	– 10 9 to + 1.8 dBm – 14 to + 11.5 dBm	+ 2.0 to – 10.7 dBm + 6 4 to – 19.1dBm	Pulse corrector, Code A, 087-57028-01 Precision networks (Note 2) NBOC (Note 1) Gain transfer C lead	Two-wire impedance: 600 or 900Ω Hybrid balance network: Compromise Adjustable Precision Signaling mode: Loop start Ground start GTD-3 EAX System alarm: Ring ground after 2 s Ring ground after 10 s Idle (no ring ground)
	91459-11 Foreign Exchange Subscriber (FXS)	600 or 900 + 2.15 µF -12: 600 or 900	– 10.9 to + 1.8 dBm – 14 to + 11.5 dBm	+ 2.0 to – 10 7 dBm + 6.4 to – 19.1dBm	Precision networks (Note 2) NBOC (Note 1) Gain transfer Seize 245Ω loop; pulse 1800Ω loop GTD-3 EAX interface	Two-wire impedance: 600 or 900Ω Hybrid balance network: Compromise Adjustable Precision Signaling mode: Loop start Ground start Auto ringdown System alarm: Tip open; ringing inhibited Tip open, then tip ground; ringing inhibited after 2 s Tip open, then tip ground; ringing inhibited after 10 s

Table 17. List of Channel Units with Test Access Through Miniature Telephone-Type Jacks (Sheet 3 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Codes and Features	Strapping Options
			Transmit	Receive		
FX	91478-11 Foreign Exchange Office (FXO)	150,600 or 1200	−17.5 to +8.0 dBm	+8.5 to −10 0dBm	Pulse corrector, Code A, 087-57028-02	Four-wire impedance: 150, 600 or 1200Ω Line Configuration: Non-Tandem Tandem Loop Length: >200 ohms <200 ohms Signaling mode: Loop start Ground start GTD-3 EAX System alarm: Ring ground inhibited Ring ground after 2 s Ring ground after 10 s
	91479-11 Foreign Exchange Subscriber (FXS)	150,600 or 1200	−17.5 to +8.0 dBm	+8.5 to −10.0 dBm	Seize 2450Ω loop; pulse 1800Ω loop	Four-wire impedance: 150, 600 or 1200Ω Line Configuration: Non-Tandem Tandem Loop Length: >600 ohms <600 ohms Signaling mode: Loop start Ground start GTD-3 EAX interface Private line auto ringdown Continuous ringing 1 s on, 3 s off 2 s on, 4 s off 0.3 s on, 0 4 s off 0 3 s on, 4 s off System alarm: Tip open; ringing inhibited Tip open, then tip ground; ringing inhibited after 2 s Tip open, then tip ground; ringing inhibited after 20 s
No sig	91451-11 Four-wire Equalized Transmission Only (ETO)	600 -22:150,600 or 1200	−17.5 to +8.0 dBm	+8 5 to −17 0 dBm	Sealing current generator, Code D, 087-54291-01 Reversible sealing current generator	Sealing Current: ON/OFF REV/NORM Four-wire impedance: 150, 600, or 1200Ω
DX Sig	91474-11 Four-wire Duplex Signaling (DX)	150,600,or 1200	−17 5 to +8 0 dBm	+8 5 to −17.0 dBm	Duplex signaling	Four-wire impedance: 150, 600, or 1200Ω Busy switch: Local to far end Remote to far end System alarm: on-hook

Table 17. List of Channel Units with Test Access Through Miniature Telephone-Type Jacks (Sheet 4 of 4).

Type	Channel Unit	Drop Impedance (Ohms)	Drop Levels		Codes and Features	Strapping Options
			Transmit	Receive		
Program	91412-xx 5/8 kHz Program Transmit	150 or 600	+ 1 to + 16 dBm		Cable equalizer -01: With equalizer -02: Without equalizer	Switch-selectable bandwidth: 5 or 8 kHz Switch-selectable preemphasis
	91413-01 5/8 kHz Program Receive	150 or 600		+ 16 to + 1 dBm		Switch-selectable bandwidth: 5 or 8 kHz Switch-selectable deemphasis
	91414-xx 5/8 kHz Program Receive	150 or 600	+ 1 to + 16 dBm		Cable equalizer -01: With equalizer -02: Without equalizer	Switch-selectable bandwidth: 5 or 8 kHz Switch-selectable preemphasis
	91415-01 5/8 kHz Program Receive	150 or 600		+ 16 to + 1 dBm		Switch-selectable bandwidth: 5 or 8 kHz Switch-selectable deemphasis
Digital data	91466-01 AR-OCUDP Data Channel	135	± 1.4 V Peak for 2.4, 4.8 19 2, and 56 kb/s ± 0.78 V Peak 9.6 kb/s		Data rate 2.4, 4.8. 9.6, 19.2 or 56 kb/s Error correction Subscriber configuration select-	Service rate - switch selectable Error correction - switch selectable Zero suppression - switch selectable Secondary channel - switch selectable DSU map or disable latching loopback
	91467-01 AR-DSODP Data Channel	135	4.5 V Peak		Data rate 2.4, 4.8. 9.6, 19.2 or 56 kb/s	Service rate - switch selectable Clear channel - switch selectable Error correction - 19.2 and 56 kb/s - switch selectable
	91468-01 AR-DSUDP Data Channel	RS-232-C 300 Min V.35 100 ± 50	0.55 V ± 20% 10V ± 5 V		Data rate: Primary Channel (Synch with or without secondary channel):2.4, 4.8. 9.6, 19.2 or 56 kb/s-64 kb/s w/o secondary channel Asynchronous: .3, 1.2, 2.4, 9 6, and 19 2 kb/s. Secondary Channel DTE Interface	Service rate - switch selectable Loop testing - switch selectable Anti-streaming - switch selectable Loop tests - switch selectable Operational Mode - switch selectable: DTE test disable error correction zero suppression SLC 96 (modes 1, 2, or 3)/D4

Notes:

1. NBO Capacitance. NBOC is strappable from 0 to 0.126 µF in 0.002-µF steps.

2. Balance Networks. Optional precision balance networks for the 91452, 91458, and 91459 channel units are listed below:

Code	Part No.	Cable Loading and Gauge
AA	087-56976-01	H88 loading; 19 or 22 AWG (0.9 or 0.63 mm)
AB	087-56977-01	H88 loading; 24 or 26 AWG (0 5 or 0.4 mm)
AC	087-56975-01	D66 loading; 19 or 22 AWG (0.9 or 0.63 mm)
AD	087-56978-01	Nonloaded cable

3. Tandem Channel Unit. The 91407-12 cannot be used on a channel that terminates in a subscriber-type channel unit of the 9002A/B channel bank. The ringing signal to the subscriber, which is transmitted via the voice path, would be blocked by the 180-3500 Hz passband of the 91407-12.

4. 91452 Two-Wire E&M Channel Unit. A DPO loop-type channel unit may work satisfactorily end-to-end with an E&M type channel unit that terminates in a common control switch. However, signaling may oscillate if the E&M channel unit terminates in a SxS switch

Table 18. List of Ancillary Equipment (Sheet 1 of 3).

Type/Part No.	Name	Description
5215B-xx	Miniature Jackfield Assembly	Connectorized jackfield with up to 96 single or double miniature telephone jacks; one rack-mounting space. See Section 342-521-100. -22 Normal-through jacks and monitor jacks for 24 four-wire vf channels; line and drop sides of jacks are wired to four chassis-mounted 50-pin connectors. -25 Bell System standard interbay patch jacks (mod, demod, and sig) for 24 channels; each jack is bridged on a through-path between two (In and Out) of six chassis-mounted 50-pin connectors; includes unwired jacks for access to battery, ground, and milliwatt supply. In a typical application, one jackfield is installed on the center rack of a three-rack group. Jackfields of adjacent three-rack groups are interconnected by three 163-10316- xx Cable Assemblies. Provides 24 six-wire patching paths accessible to all channels on the racks. The jackfields are not cabled to the channel banks. -26 Same as -25 except wired per Siemens Communication Systems standard. -43 Normal-through E&M signaling jacks for 24 channels; type I, II, or III interface; E on tip, M on ring, SG and SB wired through; line and drop sides of jacks are wired to four chassis-mounted 50-pin connectors. Code AC Two brackets that extend jackfield (4-1/8 inches) from rack.
56620-01	Writing Shelf	Retractable unit that can be installed as a writing shelf or a storage drawer; one rack mounting space; mounts from front or rear of channel-type or duct-type rack.

Table 18. List of Ancillary Equipment (Sheet 2 of 3).

Type/Part No.	Name	Description
91455-01	Fuse and Alarm Panel	Distributes -48V to six channel banks and associated equipment through nine GMT alarm-type fuses; maximum current 55 amperes; has terminals for connecting nine ground distribution circuits; has a 60-point wirewrap terminal block for interconnecting office alarm equipment and channel bank alarm circuits; has fuse alarm and bay alarm relays with form C dry contacts to control office alarm equipment; one rack mounting space. See Section 342-911-134 for circuit diagram
087-91499-01	Ribbon Cable	An 2-inch ribbon cable that connects the Digroup A TREU to the RPIU.
087-91499-02	Ribbon Cable	An 8-inch ribbon cable that connects the Digroup B TREU to the RPIU.
088-91006-xx	Wiring Harness	Extends channel bank system alarm circuits and composite clock to a 60-point wirewrap terminal block on a 91455 Fuse and Alarm Panel; has connectors that plug onto wirewrap terminals of receptacle connectors J63 and J73 (ACU's) and J62 (IU). -01 For rack assembly 91006-20 with six banks and 91455 at top of rack. -02 For rack assembly 91006-21 with five banks and 91455 at top of rack. -03 For rack assembly 91006-30 or -32 with four banks and 91455 at top of rack. -04 For rack assembly 91006-31 with three banks and 91455 at top of rack. -05 For nonstandard rack configurations; provides access to the ACU (A) and the IU of a channel bank in Mode 1; 12 feet long. -06 For nonstandard rack configurations; provides access to both ACU's and the IU of a channel bank in Mode 2 or 3; 12 feet long. -08 For rack assembly 91006-22 or -23 with five banks and 91006-33 or -34 with three banks; 91455 is near middle of rack.

Table 18. List of Ancillary Equipment (Sheet 3 of 3).

Type/Part No.	Name	Description
163-10315-xx	Cable Assembly	25-pair, 24-gauge cable with 50-pin female connector on one end, length in feet as listed below; mates with receptacle connectors on 91430 shelf. -05 25 -25 125 -45 225 -10 50 -30 150 -50 250 -15 75 -35 175 -55 275 -20 100 -40 200 -60 300
163-10316-xx	Cable Assembly	25-pair, 24-gauge cable with two 50-pin male connectors on one end and female on the other, length feet as listed below; female connector mates with receptacle connectors on 91430 shelf. -01 5 -10 50 -35 175 -02 10 -15 75 -40 200 -03 15 -20 100 -45 225 -04 20 -25 125 -50 250 -05 25 -30 150 -55 275 -60 300
163-10352-xx	Connectorized Terminal Block	8 x 25 terminal block for installation on MDF;wirewrap terminals 0.040 x 0.055 inch) five 50-pin female connectors. See Figure 42 for application. -13 Front-to-rear terminal assignments on block are T/R, T1/R1, E/SG, and SB/M. -14 Front-to-rear terminal assignments on block are T/R, T1/R1, E/M, and SG/SB.

Table 19. List of Recommended Test Equipment (Sheet 1 of 4).

Qty per Site	Test Equipment	Notes	Description and Use
1	Siemens 9140A Digital Test Set		The test set is basically a two-channel version of the 9004A channel bank. For testing or troubleshooting, it can monitor or terminate the DS1 or DS1C signal transmitted or received by the 9004B channel bank. All 9004A/B VF-type channel units can be tested in the 9140A. In an off-line looped basis, the 9140A maintains one set of 9004A common equipment and two channel units in a self-checking condition. (The common equipment includes the 91420, 91425, and 91426 units used in the 9004B.) The test set is available for rack-mounting (four spaces) and portable versions. For additional information, refer to Section 342-911-125
1	Siemens 91232 Test and Alignment Set	1	Provides a VF measuring circuit used in conjunction with external meters; supplies 1025-Hz test tone at 0 or -16 dBm; two rack mounting spaces. The digital section of the 91232 is for testing 9002A/B channel banks and is not applicable to 9004B. (Section 342-911-103 or -107)
1	Siemens 91442 VF Test Set	1	Portable or rack-mounting test set for measuring transmission level, noise, distortion, and crosstalk on an external meter such as a TTS-37B Noise Measuring Set; contains a 1020-Hz test-tone generator; connects to the channel unit TEST connector through a 796A Patch Cord; direction of test can be reversed without altering test setup; three rack mounting spaces. See Figure 38.

Table 19. List of Recommended Test Equipment (Sheet 2 of 4).

Qty per Site	Test Equipment	Notes	Description and Use
1	Siemens 91443 Test Patch Panel	1, 2	Interface between the channel unit TEST connector and external test equipment, including the 91232 Test and Alignment Set; one rack mounting space. See Figure 39. 01 Two sets of channel unit access jacks, plus option code if applicable. 02 Four sets of channel unit access jacks;option codes are not applicable Code DB Jack block equipped with 24 triple miniature trs jacks; normal-through jacks and unwired monitor jack; wirewrap terminals. DC Same as Code DB except monitor jack is wired to normal-through jacks. DE Jack block for 24 triple miniature TRS jacks (not equipped)
1	Siemens 91445 Signaling Path Test Set		Four-wire channel unit modified for VF and signaling tests on any channel; transmit/receive levels are a fixed -16/+7 dBm at the TEST connector; A and B signaling channels have switches for transmit control and LEDs for receive indications.
1	Siemens 26600 Signaling Test Set or equivalent		sends signaling pulses at selected rate and percent break; receives signaling pulses and measures percent break. (Section 108-402-106)
1	Noise Measuring Set		Noise and level measuring test set with switch-type weighting networks and hold coil
1	Impulse Noise Counter		Counts number of pulses exceeding a selected level over a selected time interval.
1	Oscillator	3	Allows optional frequency response tests, 200 to 3400Hz at 0 dBm.
1	TE820A Tekelec		Transmission DS1 frame simulator

Table 19. List of Recommended Test Equipment (Sheet 3 of 4).

Qty per Site	Test Equipment	Notes	Description and Use
1	VOM/DVM		General purpose multimeter with 20,000-ohms/volt sensitivity
2	Siemens 725A Cord (135-42822-01)		Two-conductor cable (12 feet long) wired between tip and sleeve of two 310-type tip-ring- sleeve telephone plugs; used to supply -48V power to 26600 and 9140A.
2	Siemens 796A Patch Cord (035-56967-xx)		Twelve-conductor cable with a double-sided printed circuit plug connector on each end; connects TEST receptacle connector on channel unit to channel unit receptacle connector on 91442 VF Test Set or 91443 Test Patch Panel; also usable for restoration patching between certain channel units. 796A-01 6 feet long; 035-56967-01 796A-02 12 feet long; 035-56967-02
2	Siemens 796B Test Cord (035-56501-01)	2	Two dual-conductor cables (10 feet long) with miniature tip-ring-sleeve telephone plugs on one end; the other ends terminate at a printed circuit plug connector; used to access T-R and T1-R1 leads toward the carrier at a channel unit TEST receptacle connector.
2	Siemens 796C Test Cord (035-56501-02)		Two-conductor cable (10 feet long) with a 310-type tip-ring-sleeve telephone plug on one end; the other end terminates at a printed circuit plug connector; used to access E&M leads toward the carrier at a channel unit TEST receptacle connector.
2	Siemens 6000A-01 600-Ohm Terminating Plug (135-53521-01)		Miniature telephone plug with a 600-ohm resistor (between tip and ring).
2	Siemens 6000H-01 Adapter (135-54805-01)		Converts miniature tip-ring sleeve telephone plug to 310-type plug; used with 796B Test Cord and 26600 Signaling Test Set for loop pulsing tests.

Table 19. List of Recommended Test Equipment (Sheet 4 of 4).

Qty per Site	Test Equipment	Notes	Description and Use
2	Siemens 6100B-02 Cord (135-56150-02)		Shielded two-conductor cable (10 feet long) with a miniature tip-ring-sleeve telephone plug on one end and a twin banana plug on the other end; equivalent to 6000B-02.
2	Siemens 6100C-02 Cord (135-56151-02)		Shielded two-conductor cable (10 feet long) with a miniature tip-ring-sleeve telephone plug on each end; equivalent to 6000C-02.
2	Siemens 6100D-02 Cord (135-56152-02)		Shielded two-conductor cable (10 feet long) with a 310-type tip-ring-sleeve telephone plug on one end and a miniature tip-ring-sleeve telephone plug on the other end; equivalent to 6000D-02.
24	Siemens 022-56637-01 Open Plug		Fiberglass board 1.75 x 1.08 x 0.062 inches with a 5/8-inch diameter finger hole; inserted in channel unit TEST receptacle connector to disconnect T-R, T1-R1, and E&M leads toward the office.
2	Siemens 141-54484-01 Open Plug		Dummy (plastic) miniature telephone plug.

Notes:

1. Channel Performance Tests. The 91442 VF Test Set is recommended for channel performance tests. The combination of a 91232 Test and Alignment Set and a 91443 Test Patch Panel is an alternative.

2. 91232 Test and Alignment Set. In performance tests with the 91232 test set, the channel is accessed through a 796A Patch Cord, a 91443 Test Patch Panel, and a 6100C-02 Cord. A 796B Test Cord can be substituted for the two cords and patch panel.

3. Program Channel Units. Section 342-911-126 lists additional test equipment used with program channel units.

4. Data Channel Units. Sections 342-911-160 and 342-911-161 list additional test equipment used with digital data channel units

Table 20. List of Fuses.

91436 Power Distribution Unit		
Reference Designation	Rating Amperes	Circuit
F1, F2	3	Talking battery to channel units
F3, F4	1/2	20 Hz to channel units
F5	1	– 48V to AUX PWR jack
F6, F7	2	Signaling battery to channel units
F8	2	– 48V to 91425 Power Supply Unit
91455 Fuse and Alarm Panel (Note 3)		
Reference Designation	Rating Amperes	Circuit
F1 thru F6	7-1/2	– 48V to channel bank No. 1 through No. 6
F7, F8	7-1/2 max	– 48V to auxiliary equipment
F9	1 max	– 48V to auxiliary equipment; from diode-combined A and B inputs

Notes:

1. Fuse Types. F1 and F2 on the 91436 unit are type 3AG (125-volt) slow-blow, glass cartridge fuses. All other fuses are GMT alarm-type.

2. GMT Fuses. Available sizes are identified below.

Rating, Amperes	Color Code	Siemens Communication Systems Stock Number
0.18	Yellow	175-28996-04
1/4	Violet	-05
1/2	Red	-09
3/4	Brown	-06
1	Gray	-01
1-1/3	White	-02
2	Orange	-03
3	Blue	-07
5	Green	-10
7-1/2	Black-White	-12

3. 91455 Fuse Panel. Fuses are not supplied with the panel and must be ordered separately. The total current drain should not exceed 55 amperes.

4. Fuse Cover. GMT fuses should be equipped with a plastic fuse cover, pn 122- 71501-01.

10. STANDARD ASSEMBLIES

Rack Assemblies

10.01 Standard rack arrangements of three to six channel banks (144 to 288 channels) are illustrated in Figure 43; the ordering numbers are in Figure 43a.

10.02 **Rack.** In addition to the ordering number (91006-xx), the rack type and height must be specified; see Figure 43b. Assemblies in Figure 43 are on minimum height racks. If a taller rack is ordered, the equipment will occupy the same numbered mounting positions shown.

10.03 **Equipment Mounting.** Equipment will be front- or rear-mounted as specified below: (Mounting the equipment on the rear of the rack provides more cabling space.)

(a) Unequal-flange, duct-type racks (31000-xx): rear-mounted

(b) Self-supporting, channel-type racks (31051-xx): front mounted

(c) Overhead-supported, channel-type racks (31052-xx)

(1) Height 8' or 9': front-mounted

(2) Height 11'6" or 11'8": rear-mounted

10.04 **91430 Shelf.** A 91430 shelf furnished as part of a rack assembly will include code AA or AB, as applicable, and two cable equalizers 087-54460-01. The channel assignment label and bracket (code BA or BB) and the other cable equalizers (codes DB through DE) are ordered, as required. The quantity of cable equalizers is one for Mode 1 or 2 and two for Mode 3. See Table 12.

NOTE: Equalizers are not required for any digroup that is equipped with the 91418 TREU. Shorting plugs are included with each TREU to bypass shelf equalizers.

10.05 **Plug-Ins.** Plug-in units for the channel bank are not included with the standard rack assemblies and must be ordered. Common equipment units can be ordered as a set (Figure 43c) or individually (Table 15). Channel units are ordered by type number (including dash number) and any applicable code; see Tables 16 and 17.

10.06 **Jackfields.** Jackfields, must be ordered separately; see Table 18.

10.07 **Fuses.** Refer to Table 20 for a listing of fuses required and fuses supplied with the equipment.

10.08 **Test Set.** Some rack assemblies have three mounting spaces reserved for a "Test Set," which is not included. This position may be used for a 91442 VF Test Set (three spaces) or a 91232 Test and Alignment Set (two spaces) and a 91443 Test Patch Panel (one space). Refer to Table 19.

10.09 **Rack Wiring.** Standard rack assemblies include wiring harness 088- 91006-xx connecting the channel bank alarm and composite clock circuits to the 91455 Fuse and Alarm Panel. In addition, TB1-3 on each channel bank is wired to the applicable -48V fuse on the 91455 panel and TB1-1 is wired to rack ground.

10.10 **Drop Cables.** Cables are not included and must be ordered according to the channel VF and signaling/supervisory circuit requirements. See 163-10315-xx and 163-10316-xx in Table 18.

Common Equipment

10.11 Figure 43c lists the standard assemblies for one 91430 shelf equipped with one digroup of common equipment and equipment required to equip the second digroup. The shelf will include two cable equalizers 087-54460-01, but other coded items must be ordered separately as required. See Table 15.

11. ORDERING INFORMATION

11.01 Siemens Communication Systems equipment items listed in Tables 15 through 20 and Figure 43 may be ordered by specifying the identifying numbers, including any applicable dash numbers and option codes, and the name or a brief description. Rack type and height also must be specified for the standard rack assemblies (91006-xx) in Figure 43.

11.02 Equipment may be ordered by contacting an Account Service Representative at one of the following telephone numbers:

Eastern Region:	(800) 227-5821
Central Region:	(800) 227-5826
Western Region:	(800) 227-5824
International:	(602) 395-5369 or (800) 227-5824

12. GENERAL INFORMATION

Factory Repair Service

12.01 Field repair of units is not recommended. Failed units should be replaced with a spare. Units should be tagged, with the defect or problem identified, and sent to Siemens Communication Systems, Inc., 501 Morris NE, Albuquerque, New Mexico 87123-2840, Attention Repair Center.

Technical Support Service

12.02 For technical assistance or after-hours emergency support, contact Siemens Communication Systems, Inc. Technical Services at (800) 255-1315 or (602) 395-5000. Normal business hours are 7:30 AM to 4:00 PM Mountain Standard Time.

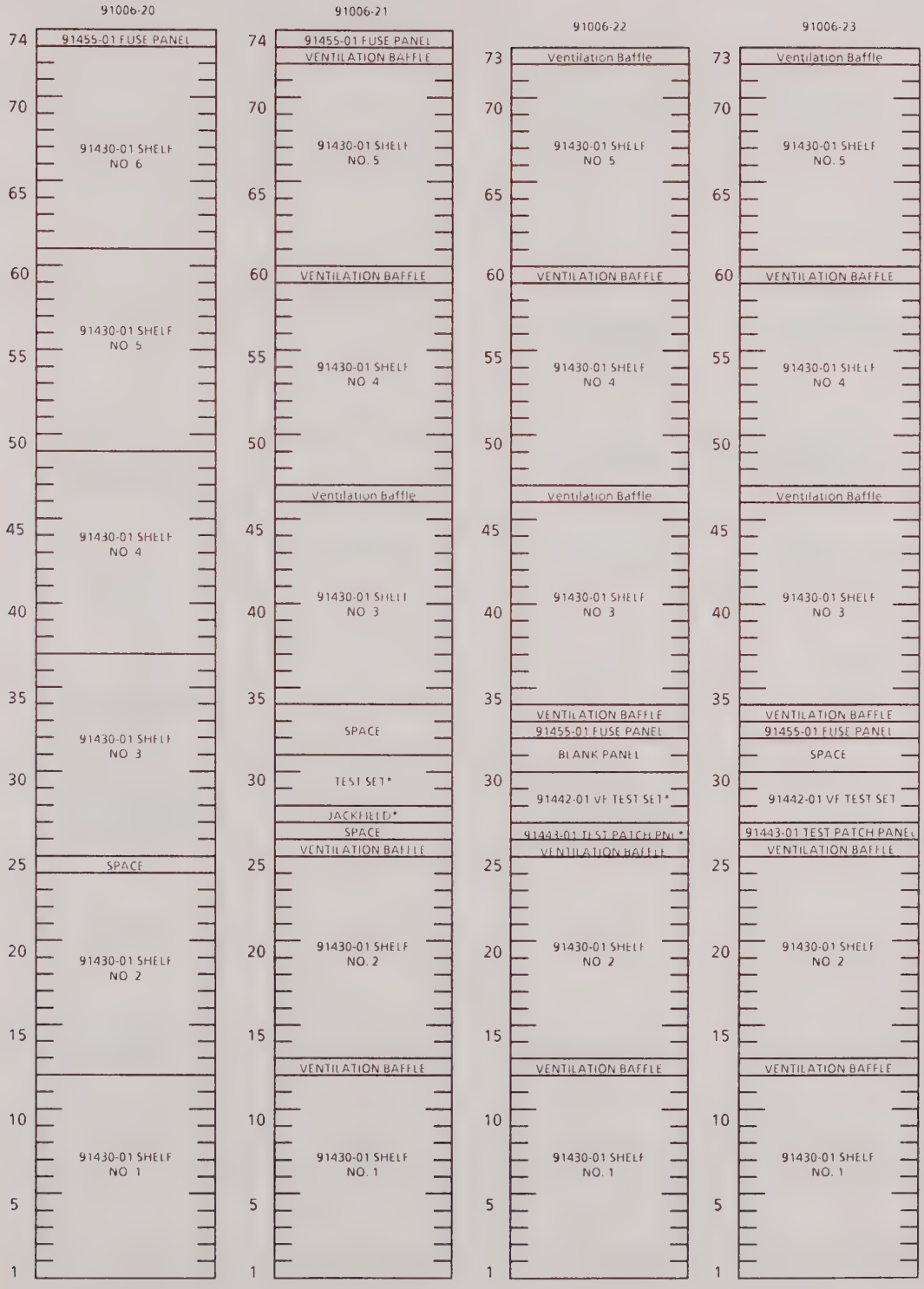
Warranty Information

12.03 All units covered by a warranty contain a warranty marking on the printed circuit side of the unit. The marking consists of the letter "S" and a four-digit date code. (For example, a warranty marking consisting of "S 0890" indicates that the warranty period starts in August, 1990.)

User Response Form

12.04 Users are encouraged to comment on this practice using the form provided at the end of this section. When applicable, identify the paragraph or page number of the topic referred to.

12.05 Upon receiving the order, Siemens Communication Systems will provide an acknowledgment and a scheduled shipping date. An equipment list showing the applicable assemblies and individual equipment items will be included in the shipment



* Not included in standard assembly; order separately

Figure 43. Standard Assemblies (Sheet 1 of 4).

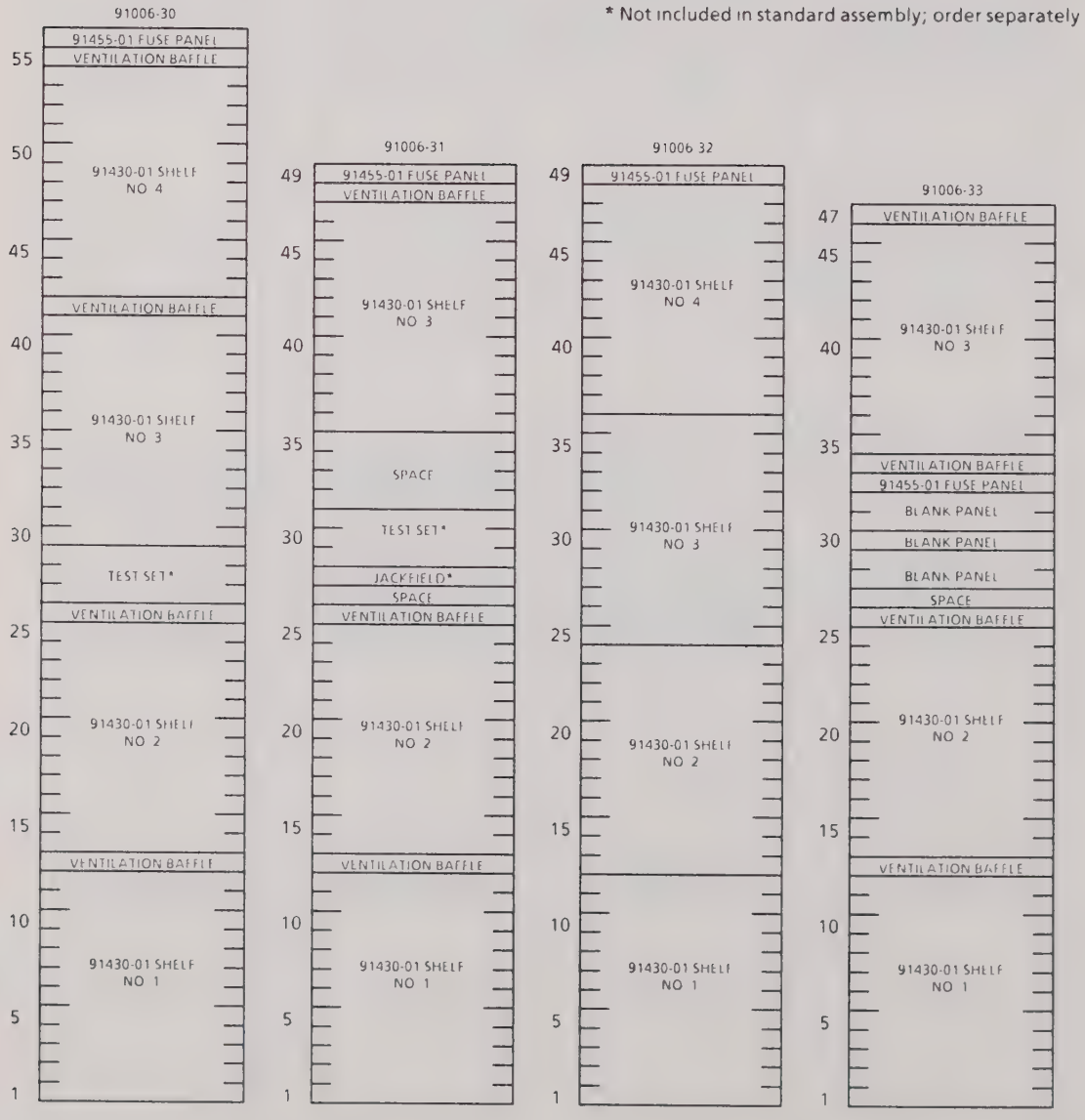


Figure 43. Standard Assemblies (Sheet 2 of 4).

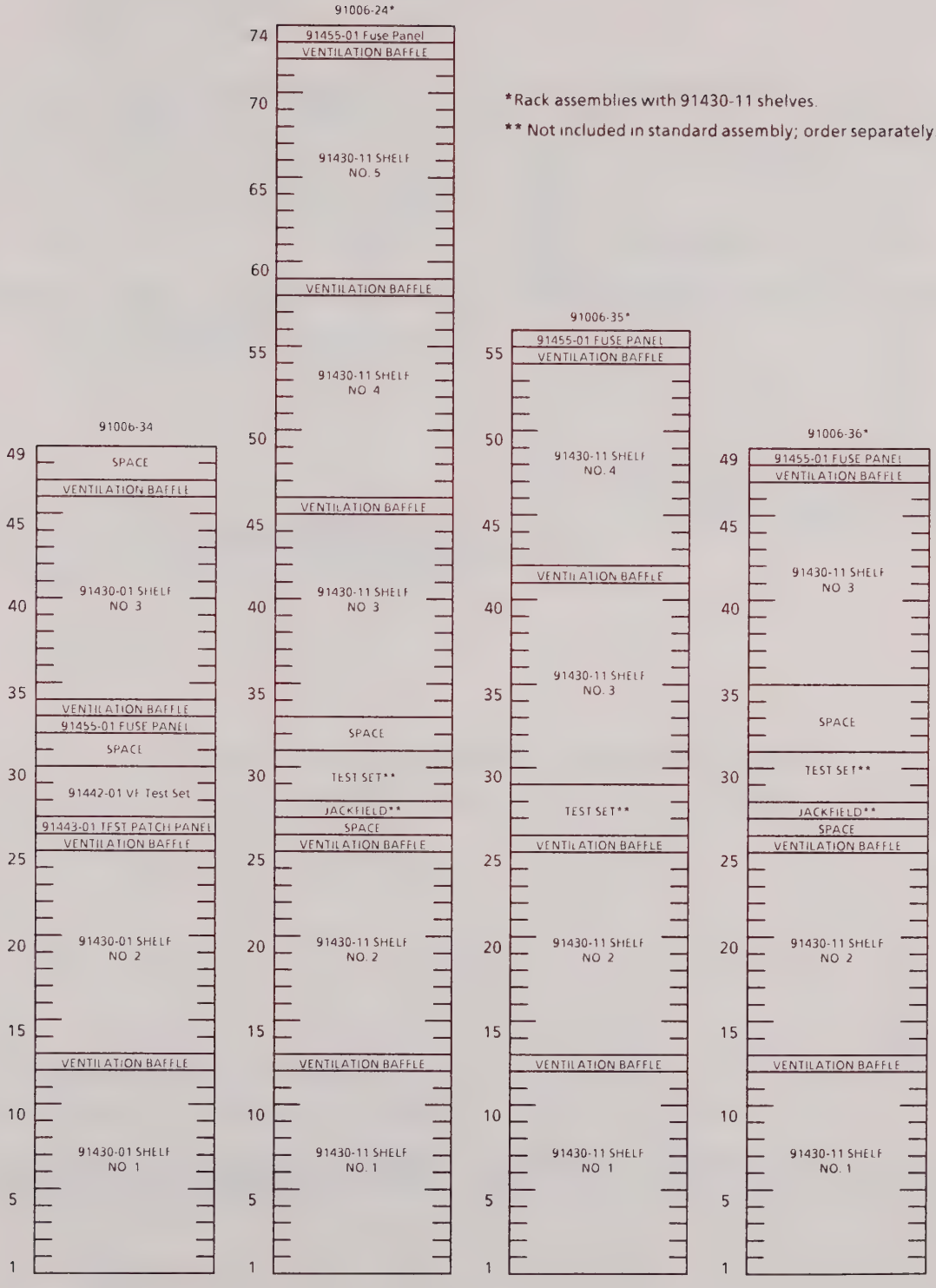


Figure 43. Standard Assemblies (Sheet 3 of 4).

FIGURE 43a RACK ASSEMBLIES.

ORDERING NUMBER	MINIMUM RACK HEIGHT	24 CHANNEL DIGROUP	91430 SHELF	
			QTY.	TYPE
91006-20	11'8"	12	6	91430-01*
-21	11'8"	10	5	-01
-22	11'6"	10	5	-01
-23	11'6"	10	5	-01
-24	11'8"	10	5	91430-11
91006-30	9'	8	4	91430-01
-31	8'	6	3	-01
-32	8'	8	4	-01*
-33	8'	6	3	-01
-34	8'	6	3	-01
-35	9'	8	4	91430-11
-36	8'	6	3	-11

* Because these configurations do not include ventilation baffles, heat buildup must be considered if the channel banks will be equipped mostly with DPO or FXS channel units. Refer to paragraphs 8.03 and 8.04.

FIGURE 43b. EQUIPMENT RACKS

TYPE NO.	HEIGHT	USABLE MOUNTING SPACE
UNEQUAL-FLANGE DUCT TYPE (ALUMINUM)		
31000-05	7'	43
-04	8'	49
-03	8'8"	54
-02	9'	56
-01	11'6"	73
-06	11'8"	74
SELF-SUPPORTING CHANNEL TYPE (ALUMINUM)		
31051-07	7'	44
-09	7'6"	47
-10	8'1/4"	51
-21	8'8"	54
-13	9'	57
-14	9'	57
-23	9'6"	60
OVERHEAD-SUPPORTED CHANNEL TYPE (ALUMINUM)		
31052-02	8'	49
-05	9'	56
-14	11'6"	73
-15	11'8"	74

FIGURE 43c. COMMON EQUIPMENT: EQUIPPED SHELVES AND LOOSE SETS OF PLUG-INS

ORDERING NUMBER	MODE	Quantity								
		91430-01 SHELF	91418-01 TREU	91420-02 ACU	91425-01 PSU	91426-01 SYNDES UNIT	91427-01 LIU	91436-01 PDU	91438-01 XMT UNIT	91439-01 RCV UNIT
91006-01	1	1		1	1		1	1	2	2
-02	2	1		2	1	1		1	2	2
-03	3	1		2	1			1	2	2
-04	3	1	2	2	1			1		
-06	1			1	1		1	1	2	2
-07	2			2	1	1		1	2	2
-08	3			2	1			1	2	2
-09*				1	1			1	1	1
-10*				1					1	1
-11	3		2	2	1			1		
-12	3		1	1	1			1		
-13	3		1	1						

* The 91006-09, which includes 91425-01 and 91436-01 units, equips a channel bank with common equipment for the first digroup (A or B) to be turned up for service in Mode 3 operation. The 91006-10 and -13 provide the common equipment for the second digroup.

Figure 43. Standard Assemblies (Sheet 4 of 4).

USER RESPONSE / REQUEST FORM

Send To: Siemens Communication Systems, Inc.
Carrier Products Group
Publications Manager, Department 535
8620 North 22nd Avenue
Phoenix, Arizona 85021

Date Submitted: _____

- Document Number (if known) _____
- Document Title or Other Identification _____
  _____
- Issue Number _____ Date _____

☐ Request for New Practice ☐ Other ☐ Date Required _____

☐ General Comments. Enter comments concerning overall organization, presentation, or content of this document in the space below.

☐ Suggested Revisions. Enter specific additions, deletions, or changes to this document in the space below, or provide a marked-up copy of the original document.

Paragraph, Figure, or Table Number | Comment

- Attach additional sheets, if necessary.
- May we contact you concerning your comments? ☐ YES ☐ NO
- May we send you information on Handbooks available to the Communications Industry? ☐ YES ☐ NO
- If yes, please enter your:
  NAME _____
  TITLE _____
  COMPANY/DEPARTMENT _____
  ADDRESS/MAIL STATION _____
  AREA CODE/TELEPHONE NO./EXT. _____

Thank you for your cooperation and comments.

Section 342-911-133
Appendix No.1
Issue 6, August 1990
DWG# AA-91006

9004B
PCM Channel Bank

9004B PCM Channel Bank
Assembly Arrangement

This drawing has been prepared for those who engineer, order, and maintain the equipment manufactured and sold by Siemens Communication Systems, Inc. The information in this drawing is subject to change and may not be suitable in all situations. Siemens Communication Systems, Inc. acknowledges that a customer's special requirements or practices may take precedence over those supplied in this drawing if a conflict develops during installation or on going operation. Siemens Communication Systems, Inc. hereby disclaims any responsibility or liability for consequential or inconsequential damages that may result from the use of this drawing.

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REVISIONS HISTORY

Issue	Date	Description	Approval
1	12-8-81	CDN 71914, Equipment Class Standard ; Original	MZ/RL
2	7-26-82	CDN 72880. Class E. In Table A, 91412, 91413 & 91465 Channel Units added. In Table C, 91441, 087-52396-01 Looping Plug and 91445-02 Test Sets added; 91449-01 Extender added; 91448 OIU added. In Table E, 91412, 91413, 91460 through 91465, 91470 & 91471 Channel Units added. In Table F, 91412, 91413, 91441, 91445-02, 91463 and 91465 Channel Units added. Code A for 91402 and 91404 deleted and Code C added.	MZ/DR
3	4-18-83	CDN 76093. Class E. In Table A, 91006-09, -10,-24, -35, -36; 91404-02, -11, -12 and Code B; 91405-11 and Code B; 91407-12; 91450-11 and Code B; 91451-11 and Code D; 91452-11, -12 and Code C; 91454-11 and Codes C and D; 91458-11 and Codes A, AA, AB, AC, AD; 91459-11 and Codes AA, AB, AC, AD added. In Table B, 91430-11 added and table updated. In Table C, 91440-01 added. Table D updated. Table E updated to show new channel units. Figure 40 rearranged and 91006-24, -35 added. In Table F, 91403-02, -11, -12 and Code B; 91405-11 and Code B; 91451 and Code D; 91452-11, -12 and Code C; 91454-11 and Codes C and D; 91458-11 and Codes A, AA, AB, AC, AD; 91459-11 and Codes A, AB, AC, AD added.	MSC/JR
4	11-23-83	CDN 99069. Class C. In Tables A, E and F, 91414-01, -02 and 91415-01 Channel Units added.	RS/DH
5	10-28-88	Reformat entire document. Adds FCC part 15 Compliance kit of parts 970-91430-01 to Table D.	TT
6	04-30-90	Reformat entire document. Add ESF equipment information.	BTT

TABLE A

Equipment Arrangements - Description of Standard Arrangements

Equipment Arrangement	Part Number	Description
Single Terminal Shelves with Common Equipment	91006-01	48 channel arrangement. Includes complete 9004B Terminal Shelf and common equipment for 48 channels and Mode 1 operation, which provides a combined 3.152 Mb/s DS1C bipolar line signal. Channel units are not included. Select channel units with specific type signaling from Table C. Shelf HF cable equalizers and accessories may be ordered as codes. Select optional equipment from Table D.
	91006-02	Same as -01 except configured for Mode 2 operation. Includes syndes unit and output is a 3.152 Mb/s DS1C signal which is compatible with an M1C Multiplexer.
	91006-03	Same as -01 except configured for Mode 3 operation which provides two 1.544 Mb/s DS1 signal outputs.
	91006-04	48 channel arrangement. Includes complete 9004B Terminal Shelf and common equipment for 48 channels and Mode 3 ESF operation which provides two 1.544 Mb/s DS1 signal outputs. Select channel units from Table C2. Select optional equipment from Table D.
Loose Common Equipment	91006-06	Provides one set of common equipment units for Mode 1 operation with both digroups.
	91006-07	Provides one set of common equipment units for Mode 2 operation with both digroups.
	91006-08	Provides one set of common equipment units for Mode 3 operation with both digroups.
	91006-09	Provides one set of common equipment to equip first digroup only for Mode 3 operation.
	91006-10	Provides one set of common equipment to equip second digroup only for Mode 3 operation.
	91006-11	Provides ESF common equipment units for Mode 3 operation with both digroups.
	91006-12	Providesone set of ESF common equipment to equip first digroup only for Mode 3 operation.
	91006-13	Provides one set of ESF common equipment to equip second digroup only for Mode 3 operation.

(Continued on sheet 5)

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TABLE A

Equipment Arrangements - Description of Standard Arrangements

Equipment Arrangement	Part Number	Description
Racked Arrangments Less Common Equipment and Channel Units	91006-20	288 Channel Arrangement. Provides six terminal equipment shelves less common equipment and channel units and a 91455 Fuse and Alarm Panel mounted at the top of an 11'-8" rack. Select rack from Table G. All drop wiring is brought out to eight connectors on each equipment shelf. Power, ground and alarm wiring are factory wired.
	91006-21	240 Channel Arrangement. Provides five terminal equipment shelves less common equipment and channel units and a 91455 Fuse and Alarm Panel mounted at the top of an 11'-8" rack. Select rack from Table G. All drop wiring is brought out to eight connectors on each equipment shelf. Each equipment shelf includes a one-mounting-space ventilation baffle. Power, ground and alarm wiring are factory wired.
	91006-22	240 Channel Arrangement. Provides five terminal equipment shelves less common equipment and channel units and a 91455 Fuse and Alarm Panel mounted in the middle of an 11'-6" rack. Select rack from Table G. All drop wiring is brought out to eight connectors on each equipment shelf. Each equipment shelf includes a one-mounting-space ventilation baffle. Power, ground and alarm wiring are factory wired.
	91006-23	240 Channel Arrangement. Same as -22 except equipped with a 91442 VF Test Set and 91433 Test Patch Panel. Mounted on a minimum 11'-6" rack. Select rack from Table G.
	91006-24	240 Channel Arrangement. Provides five 91430-11 terminal equipment shelves less common equipment and channel units and a 91455 Fuse and Alarm Panel mounted at the top of an 11'-8" rack. Select rack from Table G. All drop wiring is brought out to 10 connectors on each equipment shelf. Each equipment shelf includes a one-mounting-space ventilation baffle. Power, ground and alarm wiring is factory wired.
	91006-30	192 Channel Arrangement. Same as -21 except with four terminal equipment shelves mounted on a minimum 9'-0" rack. Select rack from Table G.
	91006-31	144 Channel Arrangement. Same as -30 except with three terminal equipment shelves mounted on a minimum 8'-0" rack. Select rack from Table G.
	91006-32	192 Channel Arrangement. Same as -20 except with four terminal equipment shelves mounted on a minimum 8'-0" rack. Select rack from Table G.
	91006-33	144 Channel Arrangement. Same as -22 except with three terminal equipment shelves mounted on a minimum 8'-0" rack. Select rack from Table G.
	91006-34	144 Channel Arrangement. Same as -33 except equipped with 91442 VF Test Set and a 91443 Test Patch Panel. Mounted on a minimum 8'-0" rack. Select rack from Table G.
	91006-35	192 Channel Arrangement. Same as -24 except with four -11 terminal equipment shelves mounted on a minimum 8'-0" rack. Select rack from Table G.
	91006-36	144 Channel Arrangement. Same as -35 except with three -11 terminal equipment shelves mounted on a minimum 8'-0" rack. Select rack from Table G.

TABLE B

Equipment Arrangements - Table of Standard Arrangements

Part Number	Description	91006-XX																							
		-01	-02	-03	-04	-06	-07	-08	-09	-10	-11	-12	-13	-20	-21	-22	-23	-24	-30	-31	-32	-33	-34	-35	-36
91418-01	Transmit and Receive ESF Unit				2						2	1	1												
91420-02	Alarm Control Unit	1	2	2	2	1	2	2	1	1	2	1	1												
91425-01	Power Supply Unit	1	1	1	1	1	1	1	1		1	1													
91426-01	Syndes Unit		1				1																		
91427-01	Line Interface Unit	1				1																			
91430-01	Terminal Equipment Shelf [1]	1	1	1	1									6	5	5	5		4	3	4	3	3		
91430-11	Terminal Equipment Shelf [1]																	5						4	3
Code AA of 91430	One-mounting-space ventilation baffle														5	6	6	5	4	3		4	4	4	3
Code AB of 91430	Top plate required if code AA not used													6							4				
91436-01	Power Distribution Unit	1	1	1	1	1	1	1	1		1	1													
91438-01	Transmit Unit	2	2	2		2	2	2	1	1															
91439-01	Receive Unit	2	2	2		2	2	2	1	1															
91442-01	VF Test Set																1						1		
91443-01	Test Patch Panel																1						1		
91455-01	Fuse and Alarm Panel													1	1	1	1	1	1	1	1	1	1	1	1
088-91006-01	Alarm Wiring Harness													1											
088-91006-02	Alarm Wiring Harness														1			1							
088-91006-03	Alarm Wiring Harness																		1		1			1	
088-91006-04	Alarm Wiring Harness																			1					1
088-91006-08	Alarm Wiring Harness															1	1					1	1		
020-90792-01	Blank Panel (1 space)															1						1			
020-90792-02	Blank Panel (2 spaces)															2						2			

[1] Terminal Equipment Shelf occupies 12 mounting spaces plus an optional 1-space ventilation baffle. It is 14 inches deep on a standard 19 inch equipment rack and weighs a maximum of 80 pounds fully equipped. Code AA or AB must be specified for each shelf. See Figure 3A and 3B for a front view of shelf configurations.

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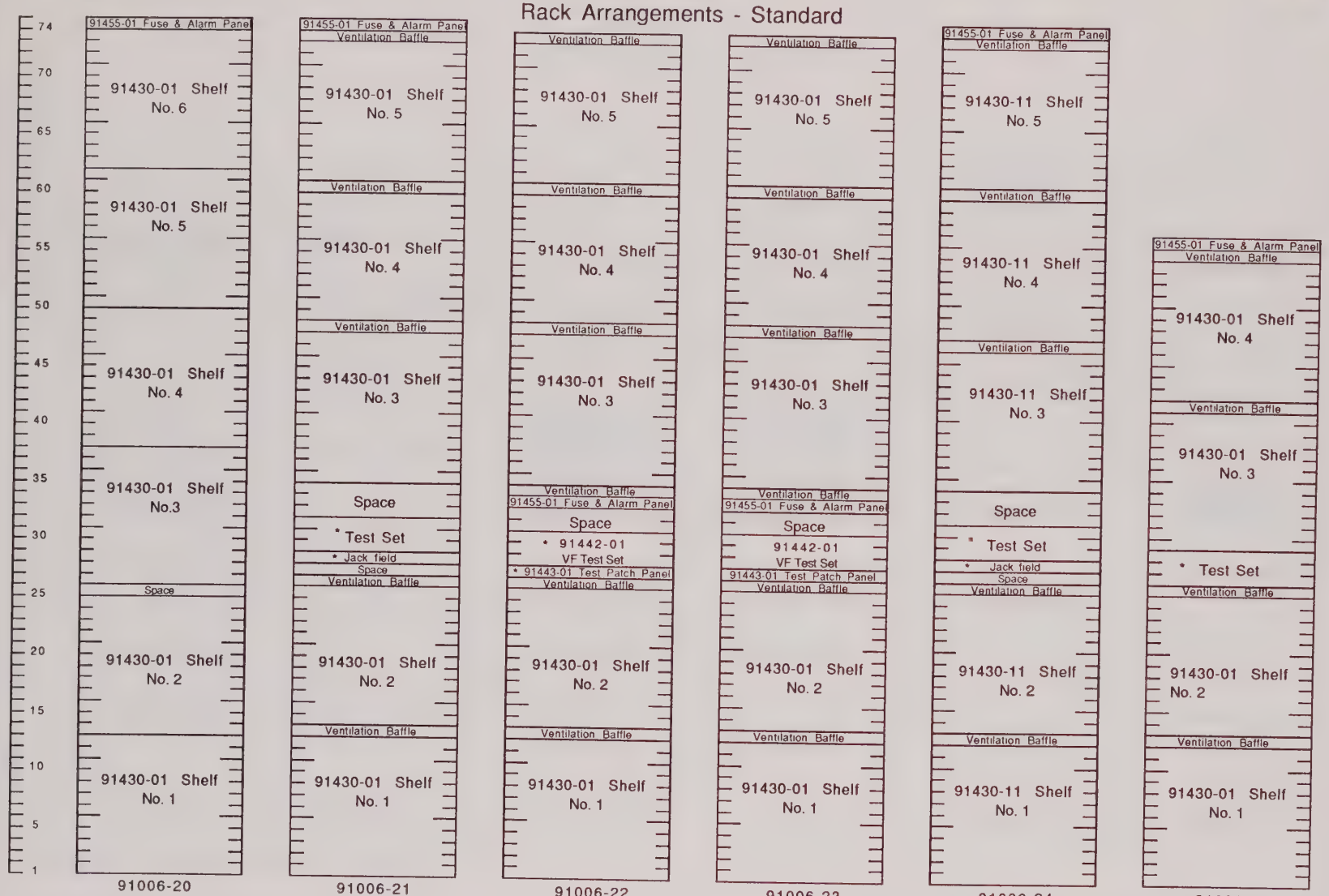
FIGURE 1

Rack Arrangements - Standard



* Not included in Standard Assembly. Order seperately.

(Continued on sheet 8)

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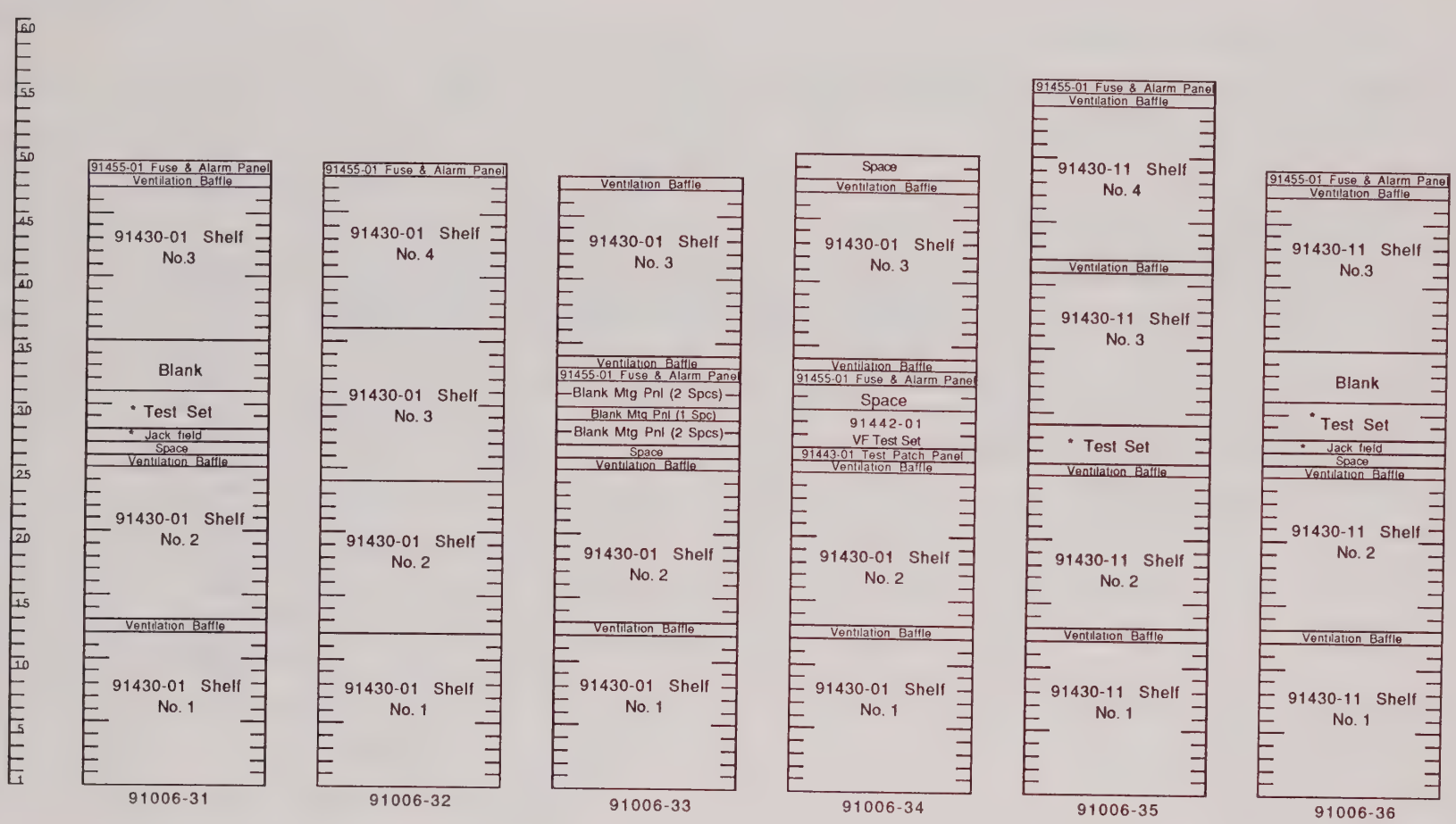
FIGURE 1

Rack Arrangements - Standard



* Not included in Standard assembly. Order seperately.

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TABLE C1

Description - Shelf and Plug-In Units

Part Number	Name	Description
91418-01	Transmit and Receive ESF Unit	The Transmit and Receive ESF Unit (TREU) is an interface between the channel units and the DS1 line. This unit provides a bipolar AMI, B8ZS or B7 stuffing, DS1 interface at 1.544Mb/s. The ESF option provides 4-k/b/s data link to pass alarm, signal quality, span performance monitoring and configuration information from the TREU to the RPIU.
91419-02	Remote Performance Interface Unit	The Remote Performance Interface Unit provides extensive performance monitoring of the DS1 spans, allows programming of the TREUs and gathers alarm related information. Includes baby board which provides sync signal and composite clock.
91420-01	Alarm Control Unit	Provides alarm control function for 9004B system.
91420-02	Alarm Control Unit	Same as -01 except equipped with peg counter.
91425-01	Power Supply Unit	Power Supply Unit. Supplies regulated DC voltages of +5V, -5V, +12V, -12V to the units of the 9004B Terminal Equipment Shelf.
91426-01	Syndes Unit (Mode 2)	Provides all the multiplexing, demultiplexing, and multiplexer alarm functions for interfacing between the common equipment units (transmit and receive) and the DS1C line for a 9004B Mode 2 channel bank.
91427-01	Line Interface Unit (Mode 1)	Provides all necessary synchronization and interfaces between two transmit units and the digital transmit line. Provides all necessary interfaces between the digital receive line and the two receive units used for Mode 1.
91430-01	Terminal Equipment Shelf	Provides a shelf to contain all the common equipment and channel units required to establish a 48 channel 9004B PCM terminal. All drop wiring is brought out to eight connectors for connectorization and ease of installation. Includes digroup A and B equalizers for 0-133 ft. to DSX.
91430-11	Terminal Equipment Shelf	Same as -01 except drop wiring is brought out to ten connectors. With one rack mounting space baffle. Required if more than 12 DPO or FXS channel units are to be installed per digroup.
91430-01 Code AA	Ventilation Baffle	Flat baffle plate (mounts on top of each shelf). Required if Code AA is not ordered. Mutually exclusive with code AB.
91430-01 Code AB	Top Plate	Flat baffle plate (mounts on top of each shelf). Required if Code AA is not ordered.
91430-01 Code BA	Channel Assignment Card	Channel assignment card for front mounted shelves.
91430-01 Code BB	Channel Assignment Card	Channel assignment card for rear mounted shelves.
91430-01 Code DB	LBO	Cable Equalizer (133-267 feet).
91430-01 Code DC	LBO	Cable Equalizer (267-400 feet).
91430-01 Code DD	LBO	Cable Equalizer (400-533 feet).
91430-01 Code DE	LBO	Cable Equalizer (533-655 feet).

(continued on sheet 10)

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TABLE C1

Description - Shelf and Plug-In Units

Part Number	Name	Description
91436-01	Power Distribution Unit	Provides two talk battery filters, ringing supply fuses, signal battery fuses and talk fuse alarm for two digroups. Power auxiliary power jack and relay contacts for alarm.
91438-01	Transmit Unit	Provides all transmit common equipment for one digroup of a 9004B PCM channel bank. Combines the 8-bit PCM words from 24 channel plus framing bits into a unipolar signal (Mode 1 or 2) or a bipolar DS1 signal (Mode 3).
91439-01	Receive Unit	Provides all receive common equipment for one digroup of a 9004B PCM channel bank. Demultiplexes the unipolar signal from the line interface, (Mode 1), or Syndes unit, (Mode 2), or the bipolar DS1 line signal, (Mode 3) to recover the digital VF and signalling information for 24 channels.
91448-01	Office Interface Unit	Extends alarm and control leads to a supervisory control system such as the Microtel System 51.
91448-02	Office Interface Unit	Same as -01 except provides composite clock interface to 9004 terminal from an external composite clock source or provides composite clock from the 9004 terminal to external termination and bit and byte sync to data channel units.
91455-01	Fuse and Alarm Panel	Fuse and Alarm Panel. Distributed -48V to channel banks through GMT alarm-type fuses; provides nine fuse positions and nine isolated ground outputs. Also provides 60-pin terminal block for alarm connections. Rack mounted, one mounting space.

TABLE C2

Description - Channel Units

Part Number	Description
91401-01	Four-wire no signal Channel Unit (600 ohms). Paddle Jack Access.
91402-01	Two-wire E & M Channel Unit (900 ohms). With A&B Leads and Paddle Jack Access.
91402-02	Two-wire E & M Channel Unit (600 ohms). With A&B Leads and Paddle Jack Access.
91402-A	Provides C lead which is controlled by busy switch and system alarm.
91403-01	Dial Pulse Originating Channel Unit (900 ohms). With NBOC Paddle Jack Access.
91403-02	Same as -01 except equipped with HS lead function.
91403-11	Same as -01 except test access is provided via mini-TRS jacks. Without NBOC. Code B - Provides network build out capacitance of 0 to 126 uF in 2 uF steps.
91403-12	Same as -11 except equipped with HS lead function. Code B - Provides network build out capacitance of 0 to 126 uF in 2 uF steps.
91404-01	Four-wire E & M Channel Unit (600 ohms). With A&B Leads, PLR function, and Paddle Jack Access.
91404-A	Provides C lead which is controlled by busy switch and system alarm.
91405-01	Dial Pulse Terminating Channel Unit (900 ohms). With NBOC and Paddle Jack Access.
91405-11	Same as -01 except test access is provided via mini-TRS jacks. Without NBOC. Code A - Provides pulse correction. Code B - Provides network build out capacitance of 0 to 126 uF in 2 uf steps. Optional on -11 only.
91407-01	Four-wire Tandem Channel Unit (600 ohms). 8 wire interface. With Paddle Jack Access.
91407-12	Four-wire Tandem Channel Unit (600 ohms). 6-wire interface equipped with mini-TRS jacks.
91408-02	Two-wire Foreign Exchange Office Channel Unit. 900 ohms or 600 ohms, W/ NBOC, Paddle Jack Access. Code A - Provides pulse correction. Code AA - Balance Network - 19/22 gauge. H88 loaded cable Code AB - Balance Network - 26/26 gauge. H88 loaded cable Code AC - Balance Network - 19/22 gauge. D66 loaded cable Code AD - Balance Network - nonloaded cable

(Continued on sheet 12)

TABLE C2

Description - Channel Units

Part Number	Description
91409-01	Two-wire Foreign Exchange Subscriber Channel Unit. 900 ohms or 600 ohms, W/ NBOC, Paddle Jack Access. Code AA - Balance Network - 19/22 gauge. H88 loaded cable Code AB - Balance Network - 26/26 gauge. H88 loaded cable Code AC - Balance Network - 19/22 gauge. D66 loaded cable Code AD - Balance Network - nonloaded cable
91411-01	Four-wire Loop Simplex Originating Channel Unit equipped with Paddle Jack.
91412-01	5/8 kHz Program Transmit Channel Unit equipped with Cable Equalizer.
91412-02	5/8 kHz Program Transmit Channel Unit without Cable Equalizer.
91413-01	5/8 kHz Program Receive Channel Unit.
91414-01	8/15 kHz Program Transmit Channel Unit equipped with Cable Equalizer.
91414-02	8/15 kHz Program Transmit Channel Unit without Cable Equalizer.
91415-01	8/15 kHz Program Receive Channel Unit.
91434-01	Four-wire Single Frequency Channel Unit. With Two State Signalling and Paddle Jack Access.
91434-12	Four-wire Single Frequency FX equipped with mini-TRS jacks.
91450-11	Stop Dial Wink Channel Unit (900 ohms). Equipped with mini-TRS jacks.
Code B of 91450	Provides network build out capacitance of 0 to 126 uF in 2 uF steps.
91451-11	Four-wire Channel Unit (600 ohms). Equipped with mini-TRS jacks.
91451-22	Four-wire with equalized transmit only with reversable sealing current generator.
91452-11	Two-wire E & M Channel Unit (900 ohms). With A&B Leads and PLR. Equipped with mini-TRS jacks.
91452-12	Two-wire E & M Channel Unit (600 ohms). With A&B Leads and PLR. Equipped with mini-TRS jacks.

(Continued on sheet 13)

TABLE C2

Description - Channel Units

Part Number	Description
Code C of 91452	Provides C lead which is controlled by busy switch and system alarm.
91454-11	Four-wire E & M Channel Unit (600 ohms). A&B Leads, PLR, and equipped with mini-TRS jacks.
Code C of 91454	Provides C lead which is controlled by busy switch and system alarm.
Code D of 91454	Provides sealing current generator.
91458-11	2 Wire Foreign Exchange Office Channel Unit . 900 or 600 ohms. Equipped with mini-TRS jacks.
91458-12	Same as 91458-11 except has gain transfer.
Code A of 91458	Provides pulse correction.
Code AA of 91458	Balance Network -19/22 gauge. H88 loaded cable
Code AB of 91458	Balance Network -24/26 gauge. H88 loaded cable
Code AC of 91458	Balance Network -19/22 gauge. D66 loaded cable
Code AD of 91458	Balance Network -nonloaded cable
91459-11	2-Wire FX Subscriber Channel Unit (900 or 600 ohms). Equipped with mini-TRS jacks.
91459-12	Same as 91459-11 except includes gain transfer.
Code AA of 91459	Balance Network -19/22 gauge. H88 loaded cable
Code AB 0f 91459	Balance Network -24/26 gauge. H88 loaded cable
Code AC of 91459	Balance Network -19/22 gauge. D66 loaded cable
Code AD of 91459	Balance Network -nonloaded cable
91466-01	OCU DP Data Channel Unit with user selectable rates 2.4, 4.8, 9.6, 19.2, or 56 kb/s.
91467-01	DSO DP Data Channel Unit with user selectable rates 2.4, 4.8, 9.6, 19.2, or 56 kb/s.

(Continued on sheet 14)

TABLE C2

Description - Channel Units

Part Number	Description
91470-01	DPO/ICT Channel Unit (VF Loop 200 - 2000 ohms) Paddle Jack
91470-02	Same as -01 except VF loop length is from 1800 to 3000 ohms.
Code AA of 91470	Balance Network - 19/22 gauge. H88 loaded cable.
Code AB of 91470	Balance Network - 24/26 gauge. H88 loaded cable.
Code AC of 91470	Balance Network - 19/22 gauge. D66 loaded cable.
Code AD of 91470	Balance Network - nonloaded cable.
91471-01	DPT/OGT Channel Unit Paddel Jack Access.
Code A of 91471	Provided Pulse Correction.
Code AA of 91471	Balance Network - 19/22 gauge. H88 loaded cable.
Code AB of 91471	Balance Network - 24/26 gauge. H88 loaded cable.
Code AC of 91471	Balance Network - 19/22 gauge. D66 loaded cable.
Code AD of 91471	Balance Network - nonloaded cable.
91474-11	Four-wire Duplex Channel Unit equipped with mini-TRS jacks.
91478-11	Four-wire FX Office Channel Unit equipped with mini-TRS jacks.
91479-11	Four-wire FX Subscriber Channel Unit equipped with mini-TRS jacks. Code A for 91479 provides pulse correction.

TABLE D

Optional Equipment and Plug-in Units

Part Number	Description
56620-01	Provides a retractable writing shelf for 19" equipment racks. Occupies one mounting space. May be mounted in an inverted position to serve as a storage drawer. Mounts from either front or rear of standard 3-inch channel and 5-inch duct racks.
91155-01	Fuse and Alarm Shelf rack mounted, two mounting spaces, equipped with relay assembly that provides two alarm lamps and office alarm outputs.
Code A of 91155-01	Fuse module equipped with eight fuse holders for fusing of eight terminals.
91419-02	Provides ESF remote performance interface access.
91420-01	Provides alarm control function for the 9004B system.
91420-02	Same as -01 except equipped with peg counter.
91440-01	Loop Access Unit. Provides testing access from terminal equipment shelf to subscriber loop. Recommended for use in digital data applications.
91443-01/02	Test Patch Panel which provides miniature TRS-TT (tiny telephone) plug access to test receptacle of channel units. Also usable for restoration patching between certain channel units. Requires two 796A patch cords, is rack mounted and occupies one space.
Code DB of 91443-02	Provides a miniature triple TRS jack panel equipped with 24 normal through jacks having unwired monitor jacks.
Code DC of 91443-02	Provides a miniature triple TRS jack panel equipped with 24 normal through jacks having wired monitor jacks.
Code DE of 91443-02	Provides a miniature triple TRS jack panel less jacks with 72 holes.
5215B-22	Provides a 4-wire jack panel with wired monitors, connectors on both line and drop sides, 24 circuits factory wired. Includes 48 triple mini-jacks.
087-54291-01	Sealing Current Generator (Suffix Code D). All -X2 Channel Units have self contained Sealing Current Generators.
087-56911-01	Pulse Correction (Suffix Code A).
087-54296-01	Network Build Out Capacitors (Suffix Code NBOC).
087-56976-01	Precision Balancing Network 19/22 gauge H88 loaded cable (Suffix Code AA).
087-56977-01	Precision Balancing Network 24/26 gauge H88 loaded cable (Suffix Code AB).
087-56978-01	Precision Balancing Network Non-Loaded cable (Suffix Code AD).
087-56975-01	Precision Balancing Network 24/26 gauge D66 loaded cable (Suffix Code AC).

(Continued on sheet 16)

TABLE D

Optional Equipment and Plug-in Units

Part Number	Description
5215B-25	Jack Panel Provides interbay patch trunks (modulator, demodulator and signaling), and miscellaneous battery, ground and milliwatt supply jacks (not connectorized, Bell standard).
5215B-26	Jack Panel Provides interbay patch trunks (modulator, demodulator and signaling), and miscellaneous battery, ground and milliwatt supply jacks (not connectorized GTE standard).
5215B-43	Jack Panel Provides fully equipped type I, II or III E & M (looped) signaling jack field with 24 circuits of E & M signaling leads (E, SG, M, SB), with jack access to E & M leads only. Includes 24 connectorized horizontal double TRS jacks.
Code AC of 5215B	Two brackets for mounting a single jackfield with 4-1/8" extension from rack. One required per 5215B-XX
140-54174-06	Molex connector which provides access to one alarm control unit connector.
140-54175-01	Molex connector pin for Molex connector. Nine pins required for one connector.
163-10352-13	8 x 24 Connectorized Terminal Block equipped with 8" fanning strip and female connectors. Front to rear terminal assignments on blocks are T/R, T1/R1, E/SG, and SB/M.
163-10352-14	Same as -13 except for terminal assignments on the block are T/R, T1/R1, E/M, and SG/SB.
020-56788-01	Channel unit plug tool. Included with each shelf. Used to remove and install option plugs.
970-91430-01	Kit of cable adapters and parts necessary for compliance with FCC regulations, part 15.
905-24421-01	Provides space for a CRT terminal and modem. This shelf contains space for one 900-24351-01 CRT Switch Unit and is mounted in a 19 inch equipment rack.
910-24199-01	Provides writing space and a location for the CRT keyboard.
900-24351-01	CRT Switching Unit providing remote maintenance access.
163-56700-01	Provides one CRT terminal and one keyboard.
163-56701-01	Provides dial-in access from the CRT Switch Unit to a remote location.

TABLE E

GMT Fuse Sizes for the
91455-01 Fuse and Alarm Panel

Fuse	Fuse Stock No.	Fuse Color	Identifier Dot
.18A	175-28996-04	YELLOW	125-37804-07
.25A	175-28996-05	VIOLET	125-27804-09
.50A	175-28996-09	RED	125-37804-05
.75A	175-28996-06	BROWN	125-37804-04
1.00A	175-28996-01	GRAY	125-37804-10
1.33A	175-28996-02	WHITE	125-37804-11
2.00A	175-28996-03	ORANGE	125-37804-06
3.00A	175-28996-07	BLUE	125-37804-08
5.00A	175-28996-10	GREEN	125-37804-12
7.50A	175-28996-12	BLK/WHT	020-51970-03
10.00A	175-28996-08	RED/WHT	020-51790-06

TABLE F

Recommended Common Equipment Spares

Part Number	Description
91418-01	Transmit and Receive ESF Unit (*Mode 3 only)
91419-02	ESF Remote Performance Interface Unit
91420-02	Alarm Control Unit
91425-01	Power Supply Unit
91426-01	Syndes Unit (*Mode 2 only)
91427-01	Line Interface Unit (*Mode 1 only)
91436-01	Power Distribution Unit
91438-01	Transmit Unit
91439-01	Receive Unit
91448-02	Office Interface Unit

In addition it is recommended that a spare channel unit inventory be maintained. The quantity and type of channel units would depend on the unique application and the individual company requirements.

TABLE G

Equipment Racks

			Mtg. Spaces	Wt. Lbs
31051-XX Equipment Rack	Provides standard telephone channel-type self-supporting equipment rack. Available in the following heights:			
	-07:	7 ft	44	40
	-09:	7 ft, 6 in	47	41
	-10:	8 ft, 1/4 in	51	43
	-14:	9 ft	57	47
	-21:	8 ft, 8 in	54	46
	-23:	9 ft, 6 in	60	48
31052-XX Equipment Rack	Provides standard telephone channel-type overhead-supported equipment rack. Available in the following heights:			
	-02:	8 ft	49	29
	-05:	9 ft	56	32
	-14:	11 ft, 6 in	73	39
	-15:	11 ft, 8 1n	74	39
31000-XX Equipment Rack	Provides unequal flange duct-type overhead-supported equipment rack fitted for 19" x 1-3/4" mounting plates. Available in the following heights:			
	-01:	11 ft, 6 in	73	36
	-02:	9 ft	56	31
	-03:	8 ft, 8 1n	54	30
	-04:	8 ft	49	28
	-05:	7 ft	43	26
	-06:	11 ft, 8 1n	74	36

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TABLE J

Interconnect Cable Assemblies

Part Number	Description
163-10315-XX	VF cable assembly, 25 pair, 24-gauge cable with a female-type connector on one end. Available in lengths as follows. Eight cables are required per 91430- shelf. -05 / 25 ft -20 / 100 ft -35 / 175 ft -50 / 250 ft -10 / 50 ft -25 / 125 ft -40 / 200 ft -55 / 275 ft -15 / 75 ft -30 / 150 ft -45 / 225 ft -60 / 300 ft
163-10316-XX	Drop cable assembly, 25-pair, 24-gauge cable with a male connector on one end and a female connector on other end. Available in lengths as follows. -05 / 25 ft -20 / 100 ft -35 / 175 ft -50 / 250 ft -10 / 50 ft -25 / 125 ft -40 / 200 ft -55 / 275 ft -15 / 75 ft -30 / 150 ft -45 / 225 ft -60 / 300 ft
087-91499-01	2 inch interconnect ribbon cable connecting the Digroup A TREU to the RPIU. (Included with 91419 and may be purchased as spares.)
087-91499-02	8 inch interconnect ribbon cable connecting the Digroup B TREU to the RPIU. (Included with 91419 and may be purchased as spares.)
088-91006-01	Universal wiring harness for interfacing up to six channel banks with the 91455 Fuse and Alarm Panel. The terminal block provides terminations for customer-wired connections. The wiring harness is equipped with 12 ten-pin Molex alarm connectors and is designed for fuse and alarm installations located at the top of the equipment rack. Applicable to Rack Assembly 91006-20.
088-91006-02	Same as -01 except for five channel banks applicable to Rack Assembly 91006-21.
088-91006-03	Same as -02 except for four channel banks applicable to Rack Assembly 91006-30 and 32.
088-91006-04	Same as -03 except for three channel banks applicable to Rack Assembly 91006-31.
088-91006-05	Nine-conductor 12-foot wiring harness terminating in a ten-pin Molex connector, for nonstandard 9004B rack arrangements.
088-91006-06	Same as -05 except with two Molex connectors for access to both 91420 Alarm Units of a channel bank in Mode 2 or Mode 3.
088-91006-08	Same as 088-91006-01 harness except designed for the 91455 Fuse and Alarm Panel is located at the middle of the equipment rack for interfacing up to five channel banks. It has 10 ten-pin Molex Connectors. Applicable to Rack Assemblies 91006-22 & 23.
087-99004-01	Equalizer bypass plug cable for RS-232 and RS-422 connections.

TABLE K

Cables, Wire, and Installation Material

Part Number	Name	Description
163-10900-73	6 AWG Stranded Power Cable	A and B power and ground cables from the overhead feeders to the Fuse & Alarm Panel.
103-11216-04	16 AWG Power Wire (Red, Stranded)	A and B power wire from the Fuse & Alarm Panel to the 9004B Backplane, TB1.
103-11216-02	16 AWG Ground Wire (Black, Stranded)	Ground wire from the Fuse & Alarm Panel to the 9004B Backplane, TB1.
163-10900-49	2 pr, 22 AWG Alarm Wire (White, Solid)	Alarm wires from the Fuse & Alarm Panel to the 9004B Backplane, J73.
137-28399-02	Power Lugs for 18-22 AWG wire	Crimp lugs used to terminate wire for placement under terminal screw.
137-49389-03	Small Cable Ties	Small cable tie (0-to 1-1/4-inch bundle) used to organize cables from the back of the shelf.
163-10291-11	Large Cable Ties	Large cable tie (0-to 4-inch bundle) used to organize cables on equipment rack.

TABLE M

Recommended Test Equipment

Equipment Type Number	Description
91441-01	Test Interface Unit, provides bit and byte clock interface from the data channel units to DDS test sets KS 20908 and KS 20909 or equivalent. Also provides paddle jack to mini TRS jack conversion accessory for manually connecting receive signals transmit path at DS0 DP.
087-52396-01	Looping plug. Loops receive signals to transmit path at DS0 DP data channel units.
91442-01	VF Test Set. Portable or rack mounted, 3 mounting spaces, as desired. Minimum of one per terminal office.
91443-01	Test Patch Panel. Provides miniature TRS-TT (tiny telephone) plug access to test receptacle of channel units. Also usable for restoration patching between certain channel units. Requires two 796A patch cords. Rack mounted, one mounting space.
91443-02 Code DB, DC or DE	Same as -01 except provides for different jack types and arrangements. Refer to Table D for details.
91445-01	Signaling Path Test Set. Enables VF and signaling/supervision to be transmitted and received through the channel bank common equipment. Has controls and indicators for the A and B signaling channels. Plugs into channel unit shelf slot.
91445-02 Model 2	Signaling Path Test Set. Provides 4-wire 2-way voice transmission for testing. Converts XMT VF signal to time multiplexed PCM signal. Time demultiplexes and converts received PCM signal. Provides for constant -16 dBm input and +7 dBm output operating VF levels. Provides connector for test access to 4-wire VF drops. Provides switch selectable (idle/busy) two channel (A & B) multiplexed XMT signaling, strappable for single channel XMT signaling. Provides RCV signaling demultiplexer and A/B idle LED indicators.
91449-01	Channel unit extender. Allows a channel unit to be extended outside of equipment shelf for testing and maintenancce. Provides pin jacks for monitoring and testing. Provides carrier and drop jacks for access to E & M, 4-wire transmit and 2-wire or 4-wire receive points.
796A-01	Test cord with 12-pin PC edge test plug on each end. Connects channel unit to 91442 VF Test Set or 91443 Test Patch Panel. Six foot length. Order quantities per local requirement.
769A-02	Same as -01 except in 12 foot length.
796B-01	Test cord provides T-R and T1-R1 carrier access from the channel unit test jack via a 12-pin PC test plug on one end and a 310 type TRS plug on the other end. Test cord is 10 feet in length.
769C-02	Test cord provides E & M carrier access from the channel unit test jack via a 12-pin PC test plug on one end and a 310 type TRS plug on the other end. Test cord is 10 feet in length.
022-56637-01	Open Plug. Opens test connector on drop side of channel unit (48 required).

(Continued on sheet 21)

TABLE M

Recommended Test Equipment

Equipment Type	Description
Noise Measuring Set	Noise and level measuring test set with switch-type weighting networks and hold coil. One per site.
Impluse Noise Counter	Counts number of pulses exceeding a selected level over a selected time interval. Impulse noise tests are optional. One per site.
204C HP Oscillator	For optional frequency response tests. 200 too 3400 Hz at 0 dBm. One per site.
TE820A Tekelec	Transmission DS1 Frame Simulator.

TABLE N

Documentation Listing *

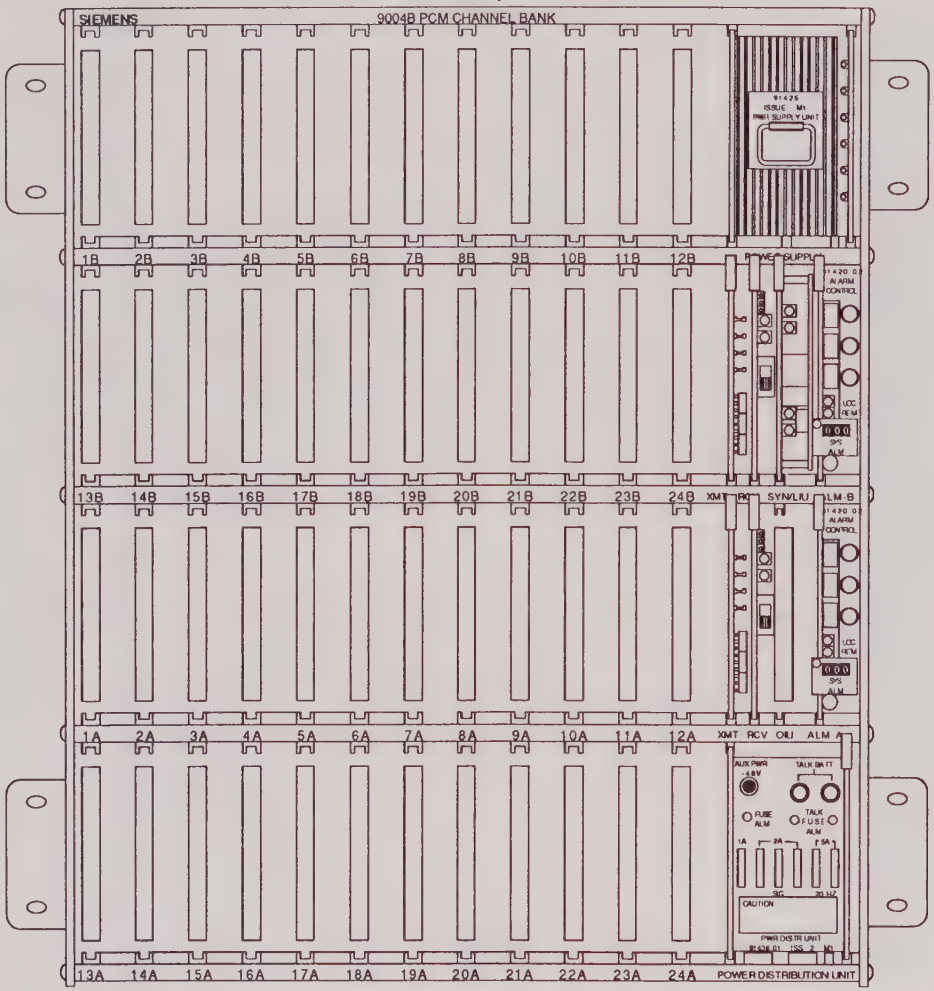
Description	
Document Number	Document Title
342-911-133	9004B Channel Bank Functional Operation, Engineering and Ordering
342-911-134	9004B Channel Bank Installation and Maintenance
342-911-550	9004B Channel Bank User's Guide
AA-91006	9004B Channel Bank Assembly Arrangement Drawings
AW-91006	9004B Channel Bank Assembly Wiring Drawings
342-911-114 thru 342-911-161	Descriptions of Channel Units (See STP 342-911-133 for listing)

* Use this reference table to select documentation which you require for the equipment being ordered. Documentation, when ordered with equipment, will be provided free of charge up to a limited quantity but must be specified on your ordering document (Purchase Order). When documentation is ordered by itself or in quantities over and above the equipment order, a nominal charge will apply. Please contact your Siemens Communication Systems, Inc. Account Representative for pricing information.

FIGURE 3A

91430-01 Terminal Equipment Shelf

Standard D4/Super Frame



(Front View)

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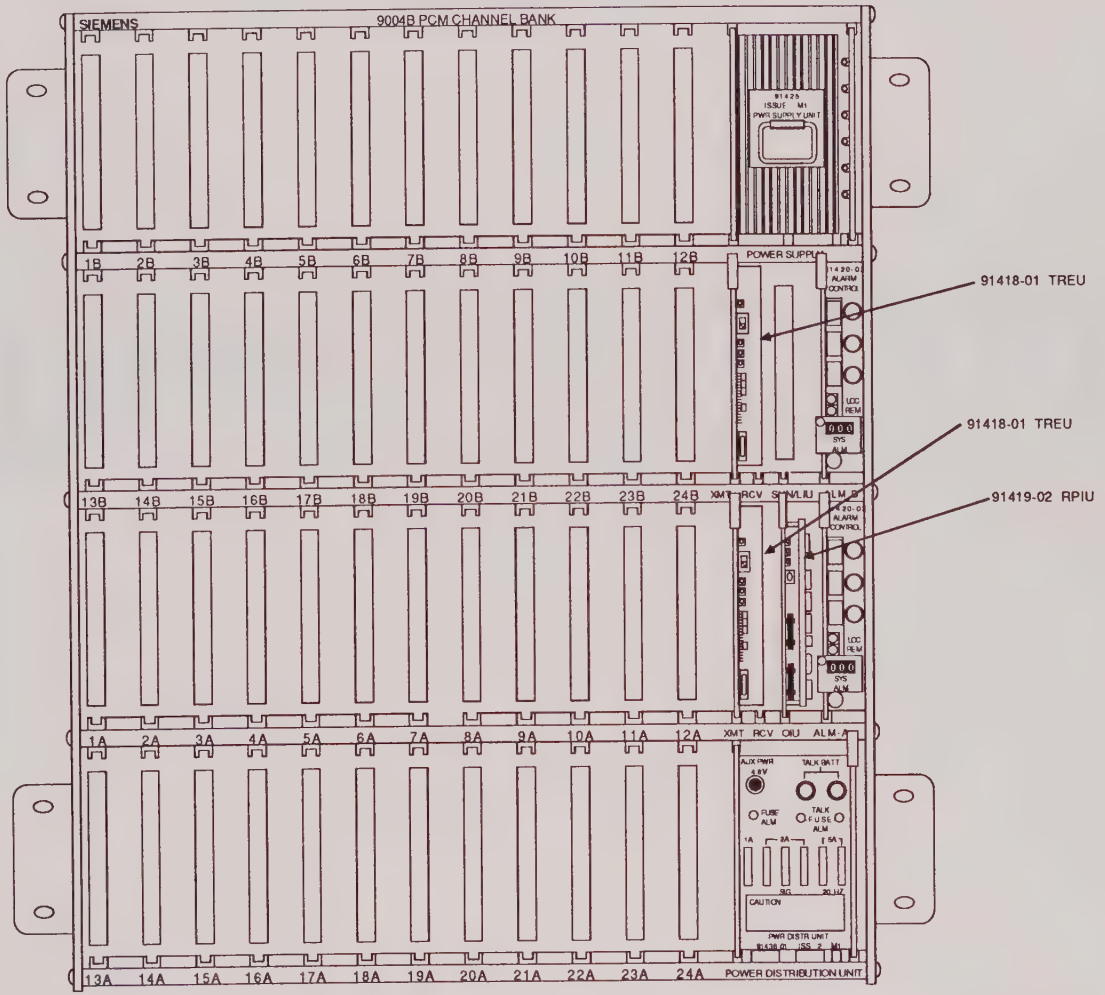
FIGURE 3B

91430-01 ESF Terminal Equipment Shelf



(Front View)

NOTE:
RPIU = Remote Performance Interface Unit, (one per 9004B)

TREU = Transmit and Receive ESF Unit, (one per digroup)

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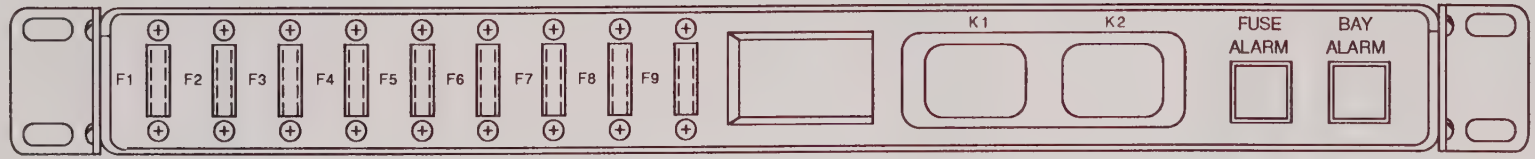
FIGURE 3C

91455-01 Fuse and Alarm Panel



(Front View)

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9004B

9004B PCM Channel Bank Installation and Maintenance

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CAUTION

AS THE ELECTRONICS INDUSTRY USES LOWER POWER AND HIGHER-DENSITY EQUIPMENT PACKAGES, THE COMPONENTS HAVE BECOME MORE AND MORE SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC DISCHARGE. IN SUCH CASES, SIEMENS COMMUNICATION SYSTEMS, INC. DESIGNS THE EQUIPMENT TO MINIMIZE THE POSSIBILITY OF FAILURE RESULTING FROM ELECTROSTATIC DISCHARGE. THE UNITS AND THEIR SHIPPING CONTAINERS ARE MARKED WITH THE ELECTRONIC INDUSTRIES ASSOCIATION (EIA) SYMBOL FOR ELECTROSTATIC-DISCHARGE-SENSITIVE DEVICES. FOR ENCLOSED UNITS, THE CASE AND THE UNIT ARE IDENTIFIED WITH THE EIA SYMBOL. HANDLE THESE UNITS ACCORDING TO YOUR COMPANY'S PROCEDURES OR REFER TO SECTION 300-000-001.

EIA Symbol

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1. GENERAL

1.01 This Practice provides installation and maintenance information for 9004B PCM Channel Bank, and includes procedures for acceptance testing, routine maintenance, and troubleshooting. Associated publications are listed in Tables 1 and 2. Channel bank functional descriptions, engineering considerations, and ordering information are provided in Practice 342-911-133.

1.02 This Practice is reissued to add information for the 91418 Transmit and Receive Extended Superframe Unit (TREU) and the 91419 Remote Performance Interface Unit (RPIU). The 91418 TREU replaces both the 91438 Transmit and the 91439 Receive Units. The 91419 RPIU replaces the 91448 Office Interface Unit. Due to the format change, change indicators have been omitted. Remove the previous issue of this Practice from the binder or microfiche file and replace it with this issue.

1.03 For Federal Communication Commission (FCC) information, see Practice 342-911-050. This Practice provides the FCC compliance (i.e., Part 15 Subpart J & Part 68) for the 9004A, 9004B, Translink I, and Translink II systems. This information is utilized when these systems are used for customer premises applications.

1.04 The equipment described in this Practice is the latest version (issue) as of the publication date. Later versions are capable of greater application or are more effective in performance of their functions than earlier versions. A later version supersedes an earlier version and may always be substituted for an earlier version.

Table 1. Associated Publications.

EQUIPMENT	SECTION
Handling Considerations for Electrostatic Discharge Sensitive Equipment	300-000-001
5215B Miniature Jackfield Assembly	342-521-100
9104A PCM Repeatered Line Equipment, Inside Plant	342-910-105
FCC Requirements for the 9004A, 9004B, Translink I, and Translink II Systems	342-911-050
9002B PCM Channel Bank (includes 91232 test set)	342-911-107
9004A PCM Channel Bank Functional Operation, Engineering, and Ordering	342-911-111
9004A PCM Channel Bank Installation and Maintenance	342-911-112
9122A Asynchronous Digital Multiplexer	342-911-122
9140A Digital Test Set	342-911-125
9004B PCM Channel Bank Functional Operation, Engineering, and Ordering	342-911-133
TRANSLINK Description, Installation, and Ordering Information	342-911-135
9004B ESF PCM Channel Bank User's Guide	342-911-550

Table 1. Associated Publications (Continued).

EQUIPMENT	SECTION
I/S NET 905-24421-01/-02 CRT Maintenance Shelf	342-930-100
Telephone Central Office Grounding of Transmission Equipment	795-805-073
Digital Signal Cross-Connects (DSX)	836-910-080

Table 2. Channel Units Supported by 9004B Channel Bank.

PART NUMBER	DESCRIPTION	REFERENCE PRACTICE
91401-01	Four-Wire (600-Ohm)	342-911-116
91402-01	Two-Wire E&M (900-Ohm)	342-911-114
91402-02	Two-Wire E&M (600-Ohm)	342-911-114
	Code 91402-C provides C Lead which is controlled by busy switch and system alarm	
91403-01	Sleeve Dial Pulse Originating	342-911-117
91403-02	Sleeve Dial Pulse Originating	342-911-117
91403-11	Sleeve Dial Pulse Originating	342-911-117
91403-12	Sleeve Dial Pulse Originating	342-911-117
	Code 91403-B provides network build-out capacitance of 0 to 126 µF in 2 µF steps on -11 and -12 units only	
91404-01	Four-Wire E&M	342-911-114
	Code 91404-C provides C Lead which is controlled by busy switch and system alarm	
91405-01	Dial Pulse Terminating	342-911-117
91405-11	Dial Pulse Terminating	342-911-117
	Code 91405-A provides pulse corrector	
	Code 91405-B provides network build-out capacitance of 0 to 126 µF in 2 µF steps on -11 units only	
91407-01	Four-Wire Tandem	342-911-119
91407-12	Four-Wire Tandem	342-911-119
91408-02	Foreign Exchange Office	342-911-115
	Code 91408-A provides pulse corrector	
	Code 91408-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91408-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91408-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91408-AD provides balance network for non-loaded cable	

NOTE: All of these channel units contain ESDS components. Special handling is required. See the caution statement on page 2.

Table 2. Channel Units Supported by 9004B Channel Bank (Continued).

PART NUMBER	DESCRIPTION	REFERENCE PRACTICE
91409-01	Foreign Exchange Subscriber	342-911-115
	Code 91409-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91409-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91409-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91409-AD provides balance network for non-loaded cable	
91411-01	Four-Wire Loop Simplex Originating	342-911-118
91412-01	5/8 kHz Program Transmit	342-911-126
91412-02	5/8 kHz Program Transmit (Without Equalizer)	342-911-126
91413-01	5/8 kHz Program Receive	342-911-126
91414-01	8/15 kHz Program Transmit (With Equalizer)	342-911-127
91414-02	8/15 kHz Program Transmit (Without Equalizer)	342-911-127
91415-01	8/15 kHz Program Receive	342-911-127
91416-11	Bridged Ringing Office	342-911-139
91417-11	Bridged Ringing Subscriber	342-911-139
91434-01	Four-Wire Single-Frequency	342-911-120
91434-12	Four-Wire Single-Frequency FX	342-911-157
91450-11	Stop Dial/Wink Originating	342-911-128
	Code 91450-B provides network build-out capacitance of 0 to 126 µF in 2 µF steps	
91451-11	Four-Wire Transmission Only	342-911-136
91451-12	Four-Wire Equalized Transmission Only	342-911-136
	Code 91451-D provides sealing current generator	
91451-22	Four-Wire Equalized Transmission Only	342-911-136
91452-11	Two-Wire E&M (900-Ohm)	342-911-129
91452-12	Two-Wire E&M (600-Ohm)	342-911-129
	Code 91452-C provides C Lead which is controlled by busy switch and system alarm	
	Code 91452-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91452-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91452-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91452-AD provides balance network for non-loaded cable	

NOTE: All of these channel units contain ESDS components. Special handling is required. See the caution statement on page 2.

Table 2. Channel Units Supported by 9004B Channel Bank (Continued).

PART NUMBER	DESCRIPTION	REFERENCE PRACTICE
91454-11	Four-Wire E&M	342-911-130
	Code 91454-C provides C Lead which is controlled by busy switch and system alarm	
	Code 91454-D provides sealing current generator	
91458-11	FX Office (Standard Gain)	342-911-131
91458-12	FX Office (Gain Transfer)	342-911-158
	Code 91458-A provides pulse corrector	
	Code 91458-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91458-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91458-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91458-AD provides balance network for non-loaded cable	
91459-11	FX Subscriber (Standard Gain)	342-911-131
91459-12	FX Subscriber (Gain Transfer)	342-911-158
	Code 91459-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91459-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91459-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91459-AD provides balance network for non-loaded cable	
91460-01	Office Channel Unit Data Port, 2.4 KB/s (With Error Detection)	342-911-132
91460-02	Office Channel Unit Data Port, 2.4 KB/s (Without Error Detection)	342-911-132
91461-01	Office Channel Unit Data Port, 4.8 KB/s (With Error Detection)	342-911-132
91461-02	Office Channel Unit Data Port, 4.8 KB/s (Without Error Detection)	342-911-132
91462-01	Office Channel Unit Data Port, 9.6 KB/s (With Error Detection)	342-911-132
91462-02	Office Channel Unit Data Port, 9.6 KB/s (Without Error Detection)	342-911-132
91463-01	Office Channel Unit Data Port, 56 KB/s (Error Correction is Strappable)	342-911-132
91464-01	DS0 Data Port, 64 KB/s (Only used at central office end)	342-911-132
91465-01	DS0 Data Port, 56 KB/s (Only used at central office end)	342-911-132
91466-01	Office Channel Unit, Data Port, User- Selectable 2.4, 4.8, 9.6, 19.2, or 56 KB/s	342-911-160

NOTE: All of these channel units contain ESDS components. Special handling is required. See the caution statement on page 2.

Table 2. Channel Units Supported by 9004B Channel Bank (Continued).

PART NUMBER	DESCRIPTION	REFERENCE PRACTICE
91467-01	DS0 Data Port, User-Selectable 2.4, 4.8, 9.6, 19.2, or 56 KB/s (Only used at central office end)	342-911-160
91470-01	Dial Pulse Originating/Incoming Trunk	342-911-121
91470-02	Dial Pulse Originating/Incoming Trunk	342-911-121
	Code 91470-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91470-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91470-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91470-AD provides balance network for non-loaded cable	
91471-01	Dial Pulse Terminating/Outgoing Trunk	342-911-121
	Code 91471-A provides pulse corrector	
	Code 91471-AA provides balance network for 19/22 gauge, H88 loaded cable	
	Code 91471-AB provides balance network for 24/26 gauge, H88 loaded cable	
	Code 91471-AC provides balance network for 19/22 gauge, D66 loaded cable	
	Code 91471-AD provides balance network for non-loaded cable	
91474-11	Four-Wire Duplex	342-911-137
91478-11	Four-Wire FX Office	342-911-138
	Code 91478-A provides pulse corrector	
91479-11	Four-Wire FX Subscriber	342-911-138

NOTE: All of these channel units contain ESDS components. Special handling is required. See the caution statement on page 2.

2. INSTALLATION

Receiving

2.01 When the equipment is received, inspect it carefully for damage. Claims for damage incurred in shipping should be reported at once directly to the transportation company involved in accordance with their instructions.

NOTE: Do not insert plug-in units into the shelf until instructed to do so in the initial power-up procedure at the end of Part 2.

2.02 The following items are provided in a cloth bag along with the 91430 Terminal Equipment Shelf:

- 1 Strapping plug extraction tool, Part No. 020-56788-01
- 8 Connector locking clips, Part No. 120-56786-01
- 1 Strapping plug, Part No. 140-56463-01
- 1 Strapping plug, Part No. 141-56699-01
- 1 Strapping plug, Part No. 141-56699-02

Mounting the Equipment

2.03 Refer to Practice 342-911-133, Functional Operation, Engineering, and Ordering for information on locating the equipment in the office and the possible need for a one-space ventilation baffle mounted directly above the channel bank on the rack.

2.04 **Optional 91455 Fuse and Alarm Panel.** The optional 91455 Fuse and Alarm Panel distributes power from the –48-volt office battery to up to six channel banks and associated equipment through nine alarm-type fuses. Channel bank audible, visual, and central office alarm circuits can be consolidated on the 91455 panel for connection to the office alarm equipment. The panel occupies one rack mounting space. Panel dimensions are shown in Figure 1.

2.05 **91430 Terminal Equipment Shelf.** The 91430 Terminal Equipment Shelf (channel bank shelf) occupies 12 mounting spaces on a standard 19-inch equipment rack. Figure 2 shows the dimensions of the shelf. Figure 3 shows the shelf equipped with common equipment units.

2.06 **Optional Ventilation Baffle (Code AA).** If a ventilation baffle is required, mount it on the rack so that the baffle plate slopes up from the rear, directing the rising heated air out the grill at the front.

Cable Equalizers

2.07 The 91430 shelf is shipped from the factory equipped with two cable equalizers, Part No. 087-54460-01. These equalizers allow the shelf to be separated from the DSX-1 or -1C cross-connect by up to 133 feet of ABAM cable. When cable lengths of up to 655 feet are required, other equalizers (Part Nos. 087-54460-02/-03/-04/-05) are available for field installation. One equalizer is required for operational Modes 1 or 2; two equalizers are required for Mode 3. Refer to Practice 342-911-133 for more information on cable equalizers.

2.08 Equalizers plug onto the male contacts of J65 and J75 at the upper left rear of the shelf as shown in Figures 4a and 4b. The component side of the equalizer is to the left and the J65 or J75 contacts enter the outboard, square openings on P1. Install the appropriate equalizer, or verify an existing installation, in accordance with the following:

NOTE: These cable equalizers are not used when the 91418 TREU is installed in the 91430 shelf. Instead of the cable equalizers, a Bypass Connector Assembly, Part No. 087-99004-01, is installed on J65 and J75. The cable equalization is done with dipswitches on the 91418 unit. Refer to the Common Equipment Strapping part of this Practice for cable equalization strapping information.

- **Mode 1 or 2.** Install the single equalizer on J65 so that pins 1-4 of P1 mate with pins 3-6 of J65. The equalizer will be centered on the "DS1C" designation on the shelf. An equalizer installed at J75 is not used and may be removed.

- **Mode 3.** Install the two equalizers so that pins 1-4 of P1 mate with pins 1-4 of J65 and J75. The equalizers will be centered on the "DS1" designations on the shelf.

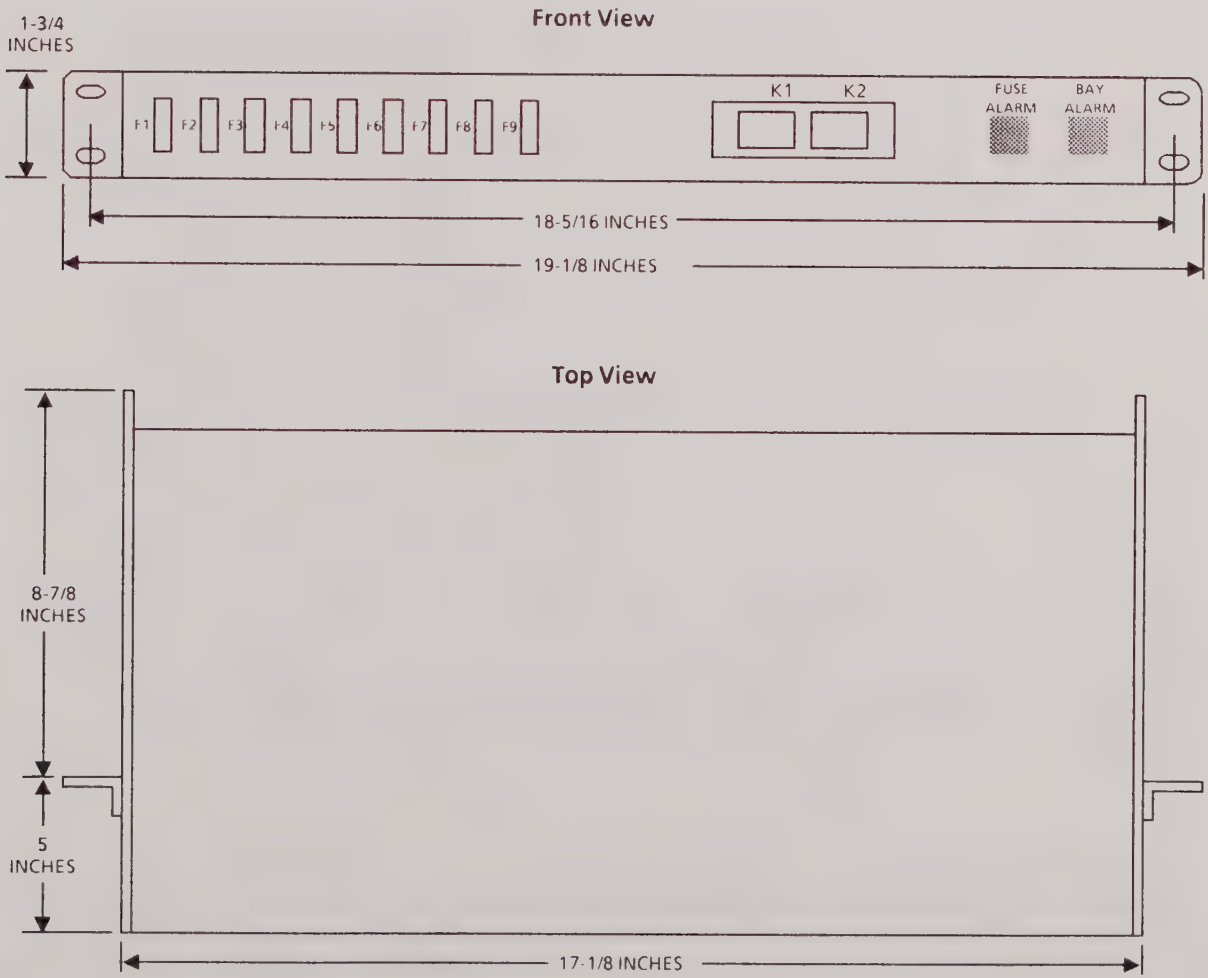
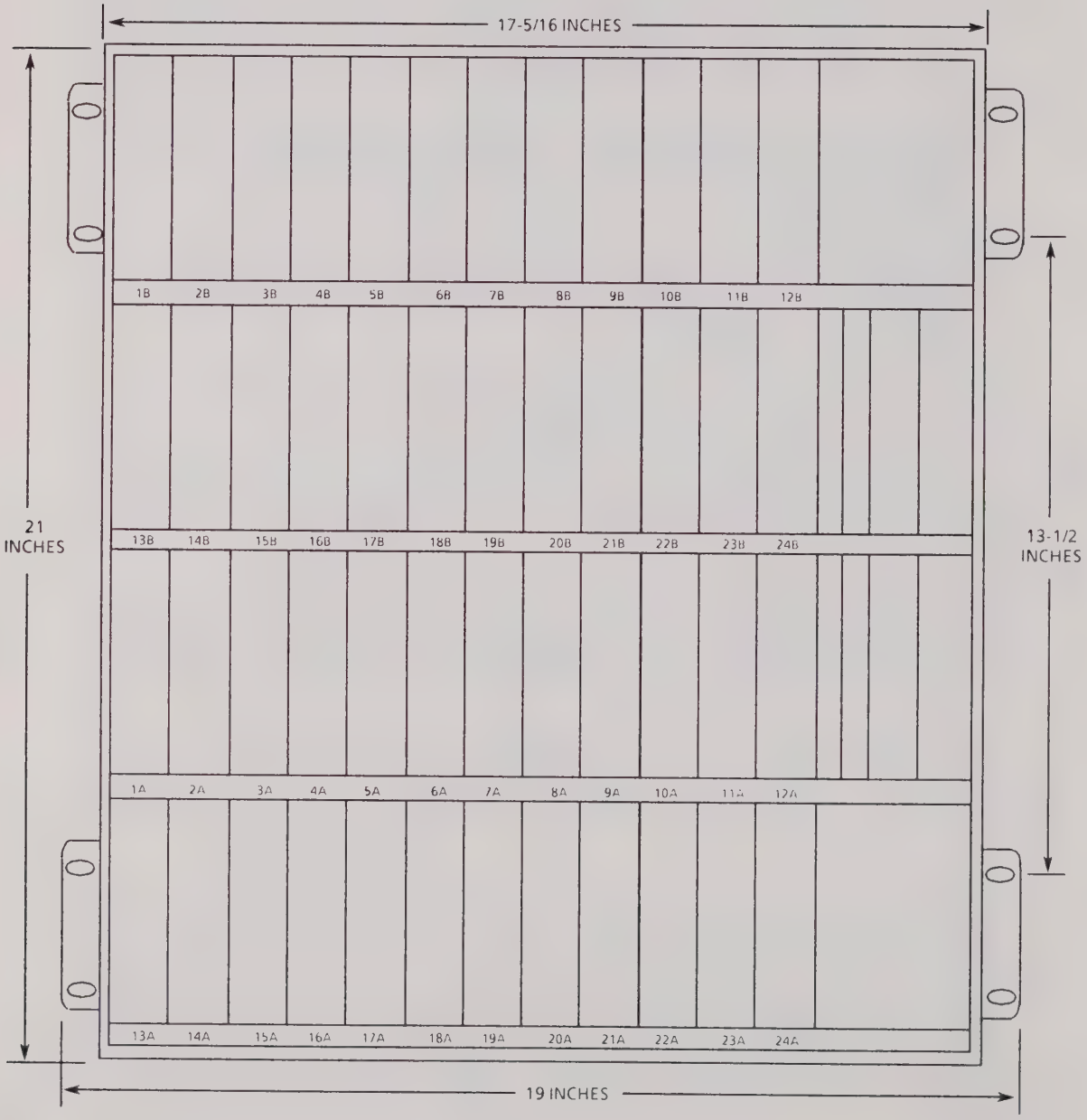
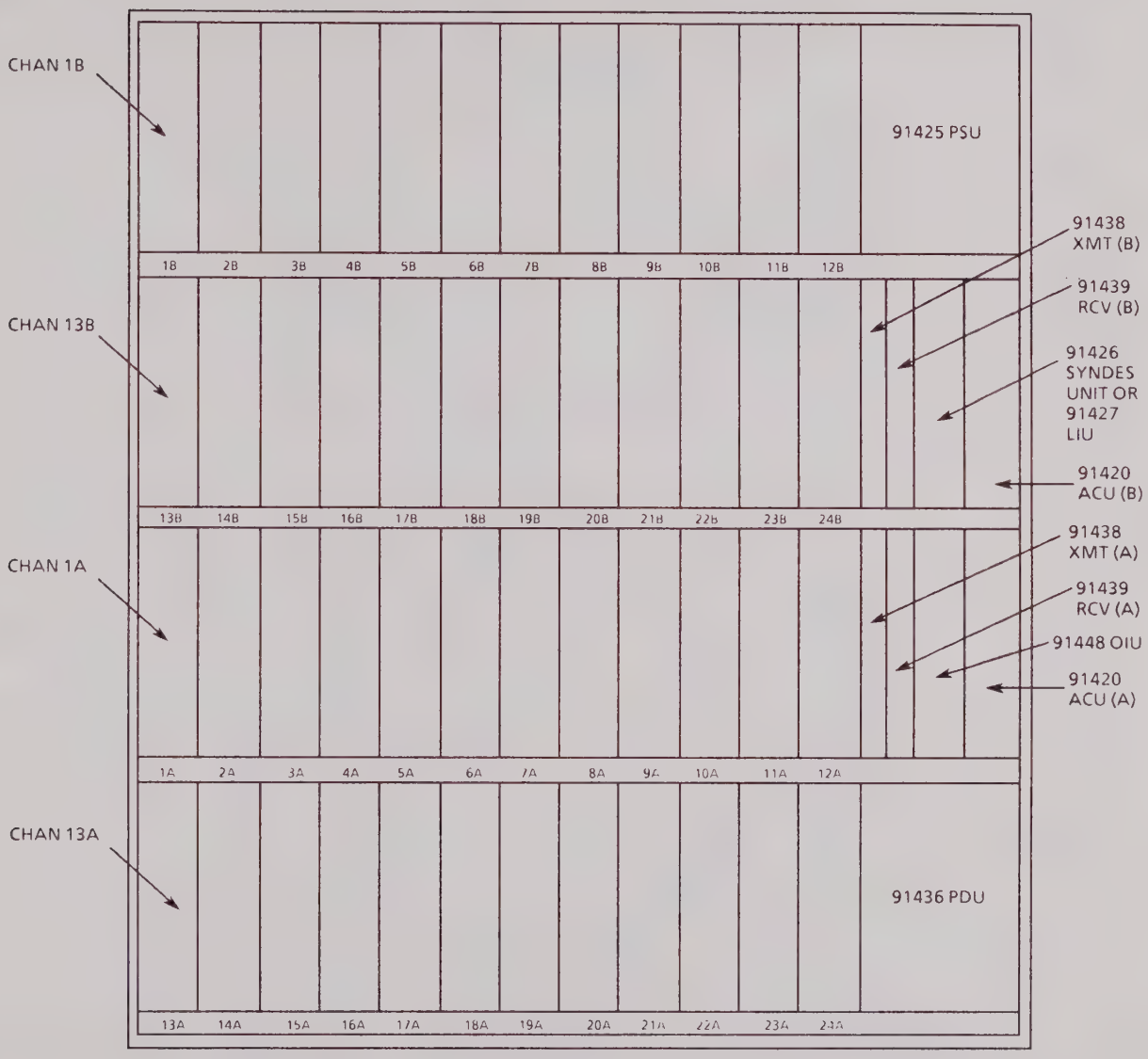


Figure 1. 91455 Fuse and Alarm Panel Dimensions.



NOTE: THE SHELF IS 14 INCHES DEEP

Figure 2. 91430 Terminal Equipment Shelf Dimensions.

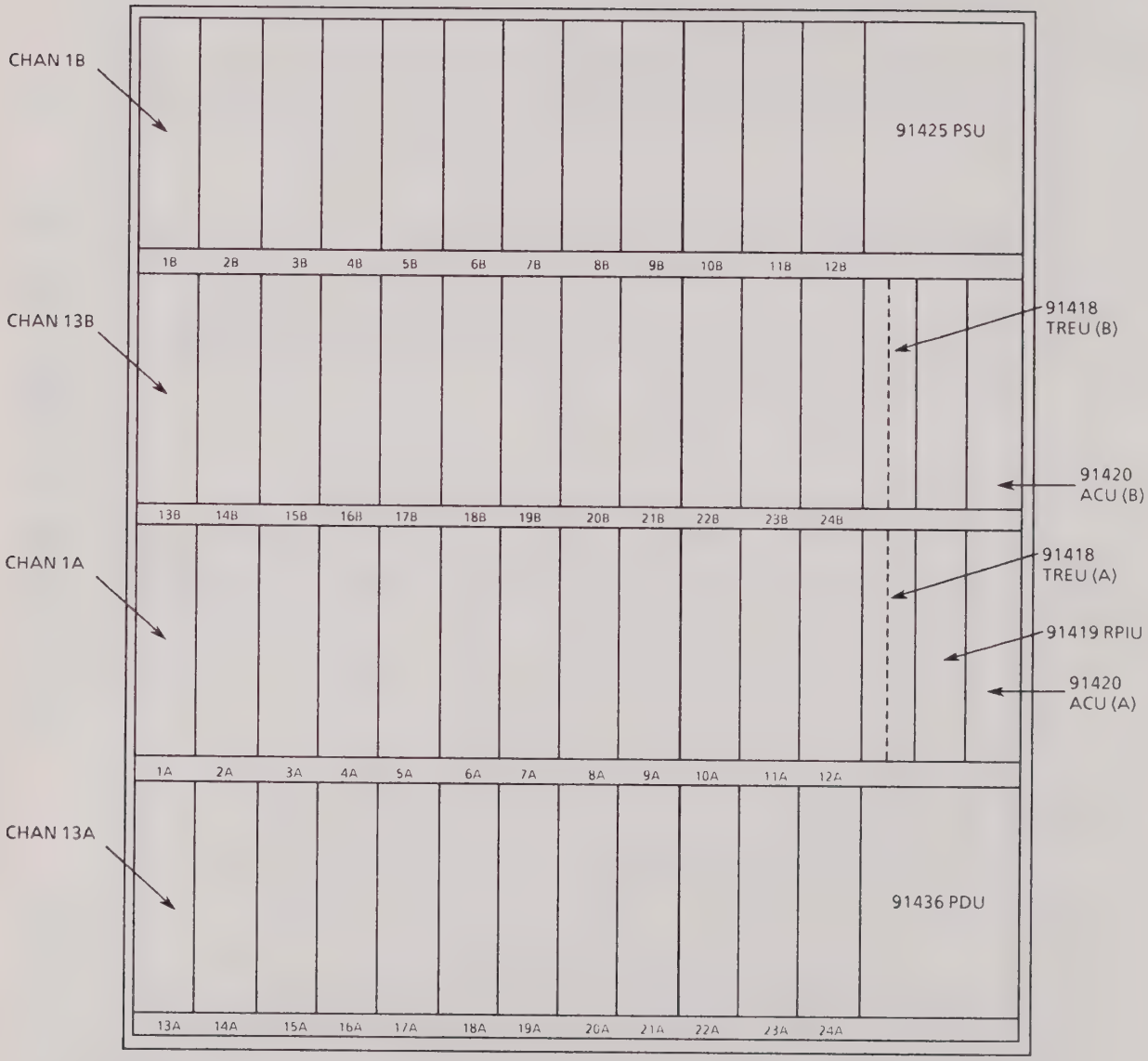


(A) = DIGROUP A
(B) = DIGROUP B
ACU = ALARM CONTROL UNIT
LIU = LINE INTERFACE UNIT
OIU = OFFICE INTERFACE UNIT

PSU = POWER SUPPLY UNIT
PDU = POWER DISTRIBUTION UNIT
SYNDES = SYNCHRONIZER - DESYNCHRONIZER
XMT = TRANSMIT UNIT
RCV = RECEIVE UNIT

Figure 3a. Equipped with 91438 XMT, 91439 RCV, and 91448 OIU.

Figure 3. 91430 Terminal Equipment Shelf Equipped with Common Units (Sheet 1 of 2).

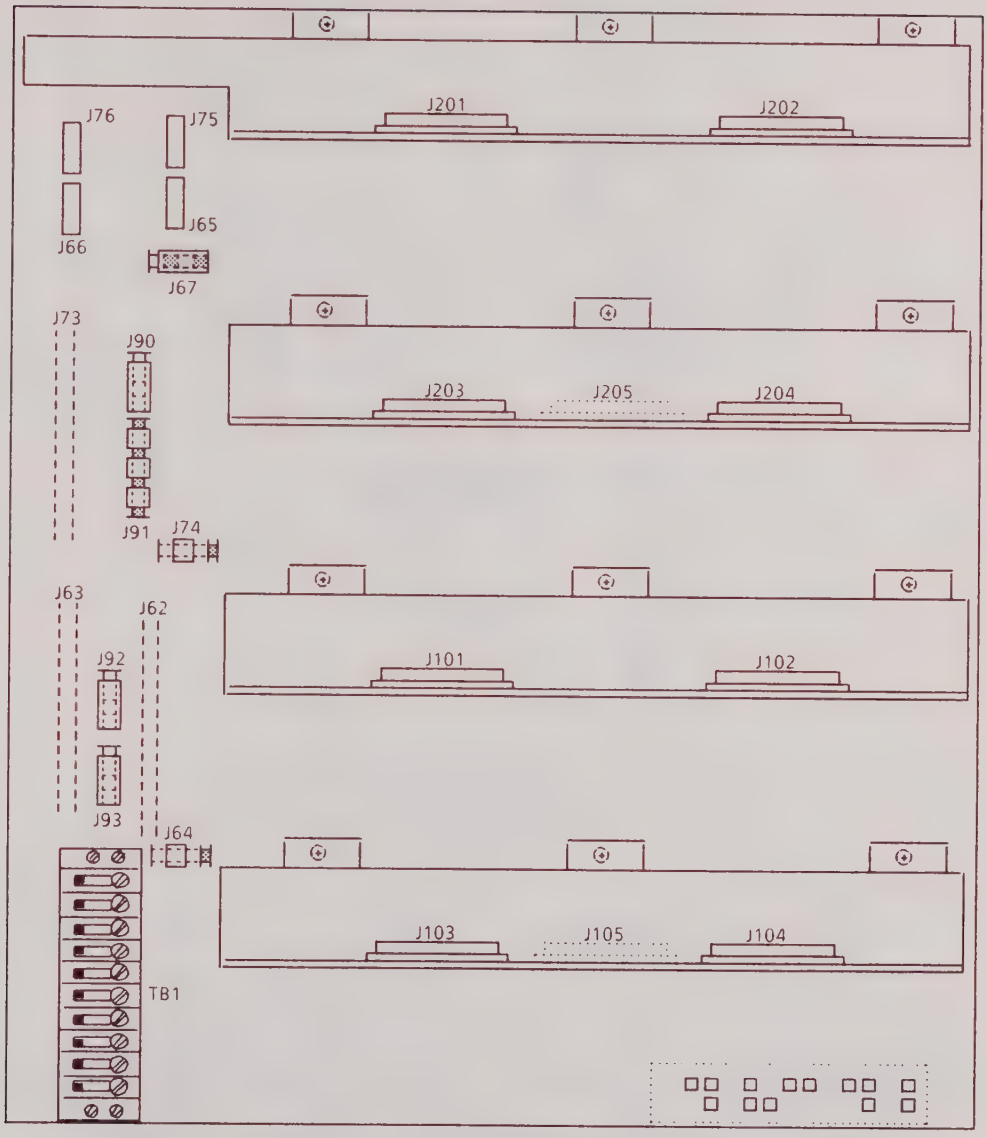


(A) = DIGROUP A
(B) = DIGROUP B
ACU = ALARM CONTROL UNIT
LIU = LINE INTERFACE UNIT

PDU = POWER DISTRIBUTION UNIT
PSU = POWER SUPPLY UNIT
RPIU = REMOTE PERFORMANCE INTERFACE UNIT (ONE PER 9004B)
TREU = TRANSMIT AND RECEIVE ESF UNIT (ONE PER DIGROUP)
(OCCUPIES 2 SLOTS)

Figure 3b. Equipped with 91418 TREU and 91419 RPIU.

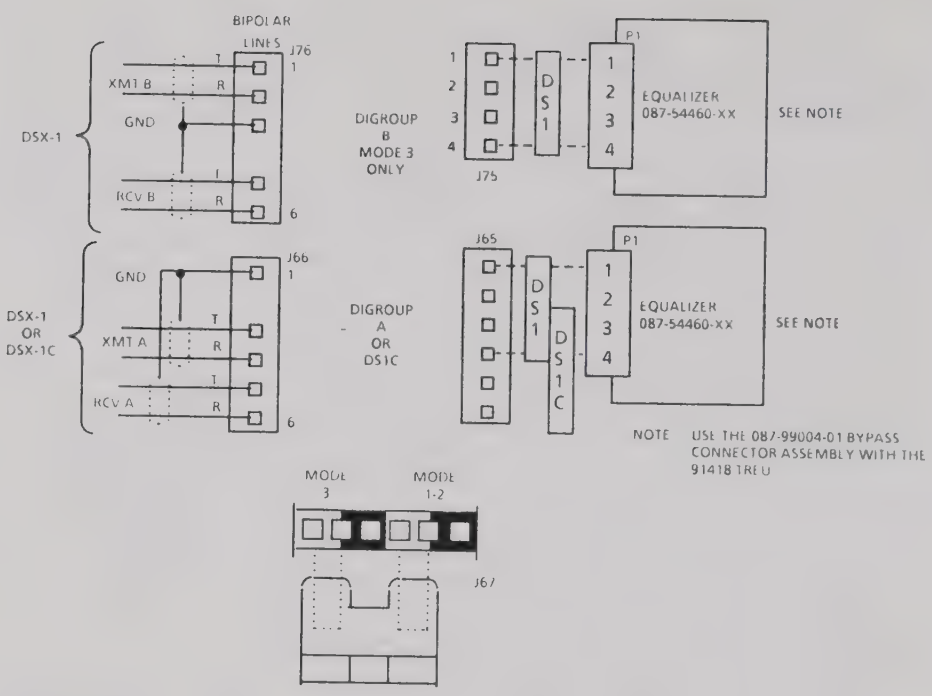
Figure 3. 91430 Terminal Equipment Shelf Equipped with Common Units (Sheet 2 of 2).



NOTE: REFER TO TABLE B1 OF AW-91006 FOR PINOUT INFORMATION.

Figure 4a. Rear View.

Figure 4. 91430 Terminal Equipment Shelf, External Connections and Strapping (Sheet 1 of 7).

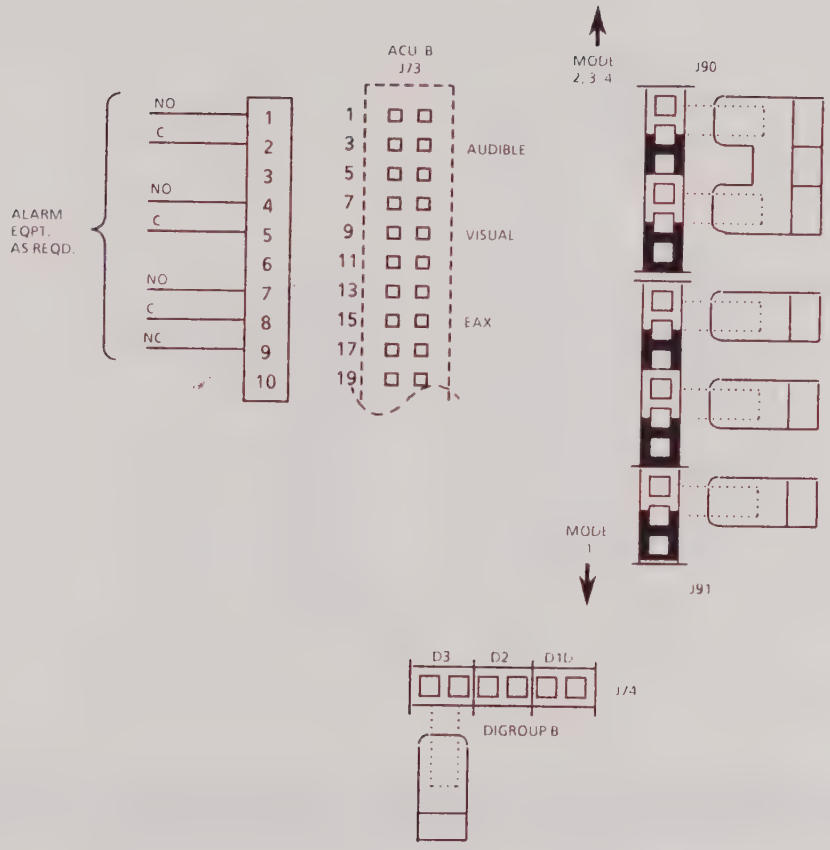


DIGITAL CABLE EQUALIZERS AND CABLE LENGTHS

CABLE EQUALIZER		LENGTH OF 22-GAUGE CABLE TO DSX-1 OR DSX-1C CROSS-CONNECT	
PART NUMBER	91430 SHELF OPTION CODE	GENERAL CABLE TYPE 4162	GENERAL CABLE TYPE 4503
087-54460-01		0 to 110 Feet	0 to 133 Feet
087-54460-02	DB	110 to 222 Feet	133 to 267 Feet
087-54460-03	DC	222 to 232 Feet	267 to 400 Feet
087-54460-04	DD	332 to 442 Feet	400 to 533 Feet
087-54460-05	DE	442 to 544 Feet	533 to 655 Feet

Figure 4b. Digital Lines and Equalizers.

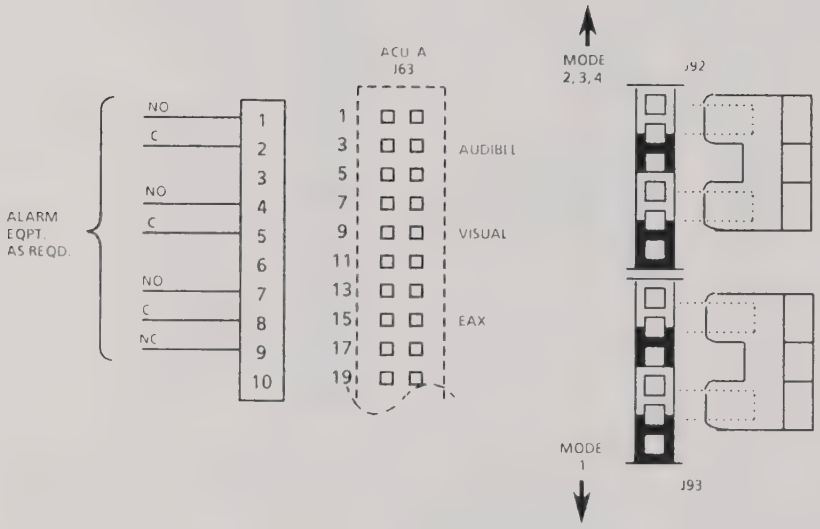
4. 91430 Terminal Equipment Shelf, External Connections and Strapping (Sheet 2 of 7).



SYSTEM ALARM AND COMPOSITE CLOCK. CONNECTORS THAT PLUG INTO WIREWRAP TERMINALS OFJ62, J63 AND J73 ARE PART OF WIRING HARNESS 089-91006-XX. SEE FIGURE 6. FOR LOCALLY FABRICATED WIRING HARNESS, SEE FIGURE 7

Figure 4c. Digroup B, System Alarm and Channel Sequence.

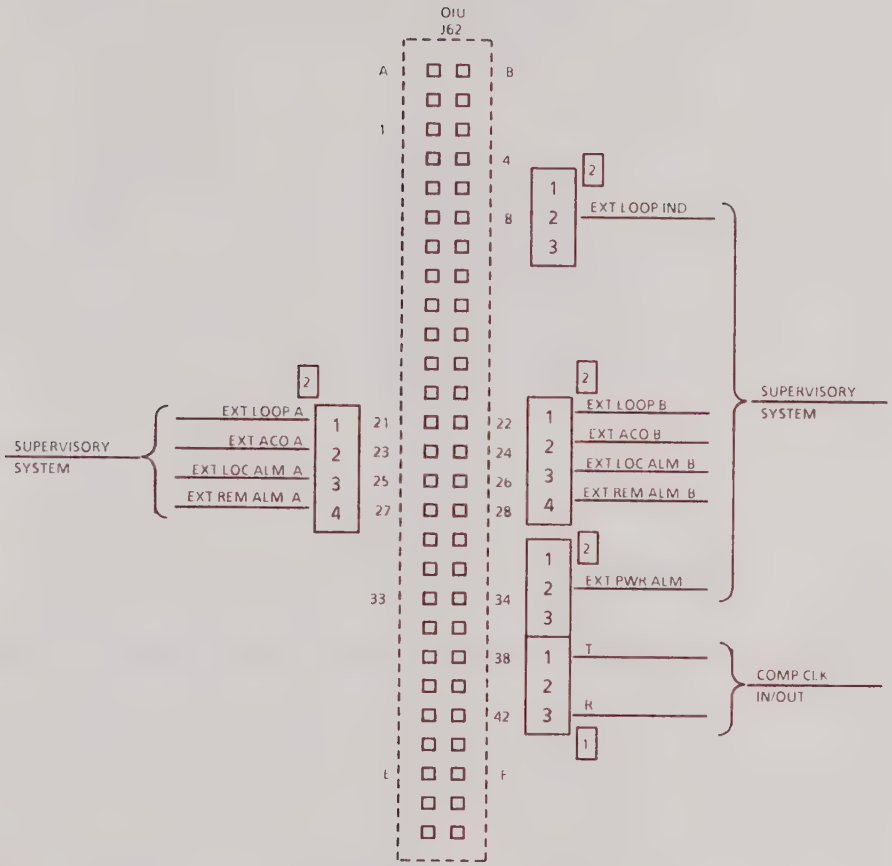
e 4. 91430 Terminal Equipment Shelf, External Connections and Strapping (Sheet 3 of 7).



NOTE: SYSTEM ALARM AND COMPOSITE CLOCK CONNECTORS THAT PLUG INTO WIREWRAP TERMINALS OFJ62, J63 AND J73 ARE PART OF WIRING HARNESS 089-91006-XX SEE FIGURE 6 FOR LOCALLY FABRICATED WIRING HARNESS, SEE FIGURE 7

Figure 4d. Digroup A, System Alarm.

Figure 4. 91430 Terminal Equipment Shelf External Connections and Strapping (Sheet 4 of 7).

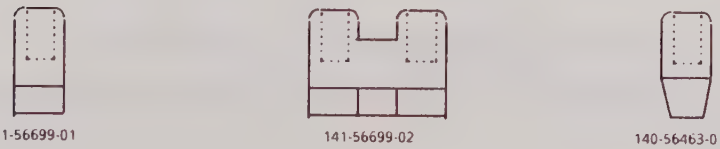


NOTES:

1. SYSTEM ALARM AND COMPOSITE CLOCK. CONNECTORS THAT PLUG INTO WIREWRAP TERMINALS OFJ62, J63 AND J73 ARE PART OF WIRING HARNESS 089-91006-XX SEE FIGURE 6. FOR LOCALLY FABRICATED WIRING HARNESS, SEE FIGURE 7

2. SUPERVISORY SYSTEM. CONNECTORS THAT PLUG ONTO WIREWRAP TERMINALS OF J62 ARE PART OF A LOCALLY FABRICATED WIRING HARNESS. SEE FIGURE 7.

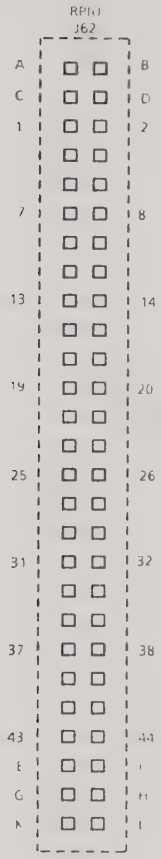
STRAPPING PLUGS



141-56699-01 141-56699-02 140-56463-01

Figure 4e. Supervisory System and Composite Clock for 91448 OIU.

Figure 4. 91430 Terminal Equipment Shelf External Connections and Strapping (Sheet 5 of 7).



91419 RPIU BACKPLANE PINOUTS

PINOUT	DIRECTION	FUNCTION
A	NONE	NONE
B	NONE	NONE
C	NONE	NONE
D	NONE	NONE
1	OUTPUT	EXT LOOP $\overline{B}$
2	INPUT	– AC5 B
3	INPUT	– AY $\overline{B}$
4	OUTPUT	EXT CLK
5	INPUT	– AR $\overline{B}$
6	INPUT	CH PR-24A'
7	OUTPUT	ACO2 $\overline{B}$
8	OUTPUT	DEGPNC
9	OUTPUT	ACO1 $\overline{B}$
10	INPUT	PWR ALM
11	NONE	NONE
12	NONE	NONE
13	OUTPUT	BIT SYNC'
14	INPUT	CH PR-24B'
15	OUTPUT	BYTE SYNC'
16	INPUT	NONE
17	OUTPUT	TXD 232
18	INPUT	RXD 232
19	OUTPUT	SGND 232
20	INPUT	RTS 232
21	OUTPUT	CTS 232
22	INPUT	DSR 232
23	INPUT	DCD 232

91419 RPIU BACKPLANE PINOUTS

PINOUT	DIRECTION	FUNCTION
24	OUTPUT	DTR 232
25	OUTPUT	TXD 422A
26	OUTPUT	TXD 422B
27	INPUT	RXD 422A
28	INPUT	RXD 422B
29	INPUT	GND
30	INPUT	GND
31	INPUT	+ 5 VOLTS
32	OUTPUT	DEGPC
33	INPUT	– AC5 $\overline{A}$
34	OUTPUT	DEGPNO
35	OUTPUT	EXTLP $\overline{A}$
36	OUTPUT	NONE
37	INPUT	– AY $\overline{A}$
38	I/O	T COMPOSIT CLK
39	INPUT	– AR $\overline{A}$
40	INPUT	– 12 VOLTS
41	OUTPUT	ACO2 $\overline{A}$
42	I/O	R COMPOSIT CLK
43	OUTPUT	ACO1 $\overline{A}$
44	NONE	NONE
E	NONE	NONE
F	NONE	NONE
G	NONE	NONE
H	NONE	NONE
K	OUTPUT	SGND 422
L	NONE	NONE

Figure 4f. Backplane Pinouts for 91419 RPIU.

Figure 4. 91430 Terminal Equipment Shelf External Connections and Strapping (Sheet 6 of 7).

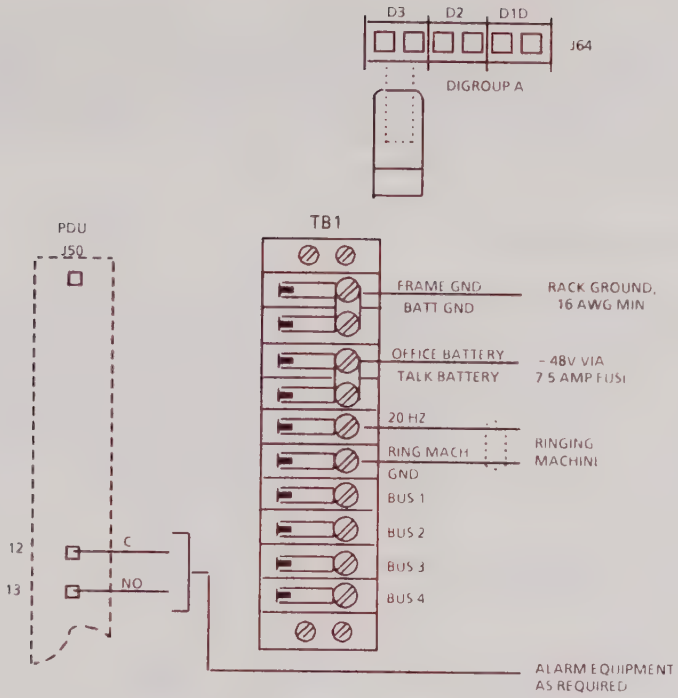


Figure 4g. Power Input, Fuse Alarm, and Digroup A Channel Sequence.

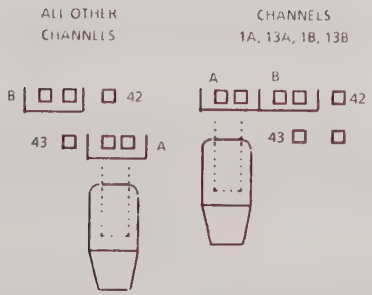


Figure 4h. TMB Strapping.

Figure 4. 91430 Terminal Equipment Shelf External Connections and Strapping (Sheet 7 of 7).

Office Wiring

2.09 Figure 4 shows the terminations of external wiring and cables on the 91430 shelf. Figure 5 shows the internal circuits of the 91455 Fuse and Alarm Panel and the interconnections to the channel bank alarm and composite clock circuits. Refer to Practice 342-911-133 for recommended wire and cable types and gauges.

Power Wiring

2.10 If the installation includes the 91455 Fuse and Alarm Panel, wire the office battery and ground leads to TB1 on the panel as shown in Figure 5, Sheet 1. The clamp-type terminals accept wire sizes up to 6 AWG. Install the power input and ground leads in TB1 on the concave bottom portion of the terminal assembly under the U-link, if it is used. Tighten the setscrews securely. Alternatives to the arrangement in Figure 5, Sheet 1 are as follows:

- If separate A and B power distribution is used, remove the jumper between TB1-3 and -4.

- If separate battery ground and rack ground connections are required, remove the jumper between TB1-1 and -2.

NOTE: Grounding should be in accordance with Section 795-805-073.

2.11 Office battery is distributed to the channel banks and auxiliary equipment from TB2 on the 91455 panel. The clamp-type terminals on TB2 accept wire sizes up to 12 AWG.

2.12 Wire office battery and ground, and the 20-Hz ringing supply if required, to TB1 on the 91430 shelf as shown in Figure 4g. Alternatives are as follows:

- If separate battery ground and rack ground connections are required, remove the electrical clip (Part No. 137-49295-01) between TB1-1 and -2 and wire the battery ground lead to TB1-2.

- If an external talk battery filter is used, remove the electrical clip between TB1-3 and -4 and wire the talk battery lead to TB1-4.

Alarm and Composite Clock Wiring

2.13 Connections to the channel bank system alarm and fuse alarm circuits are made according to the office alarm requirements. Composite clock distribution is required for certain digital data applications.

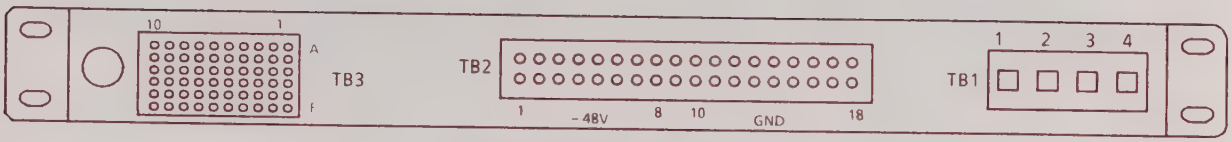


Figure b. Rear View.

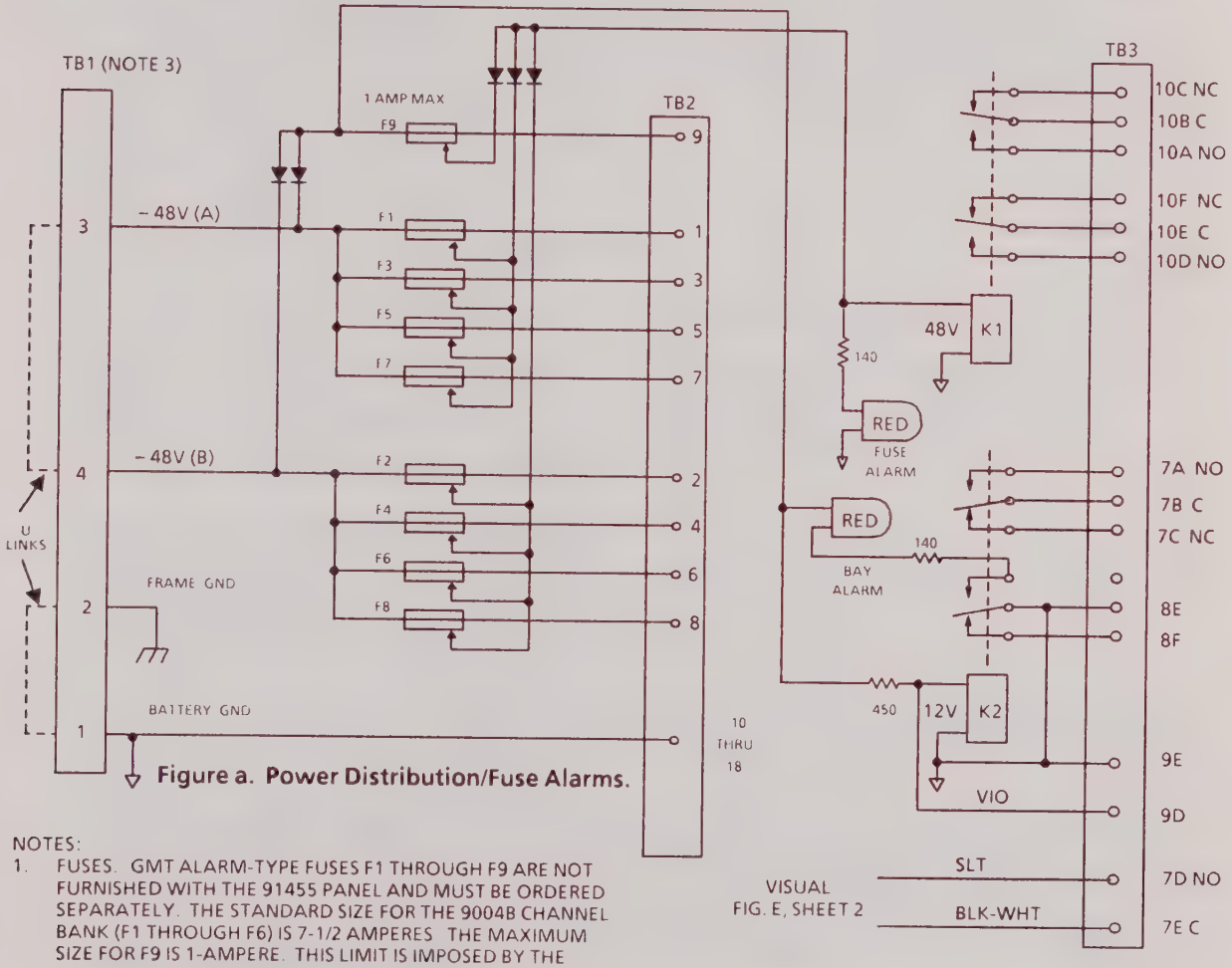


Figure a. Power Distribution/Fuse Alarms.

NOTES:

1. FUSES. GMT ALARM-TYPE FUSES F1 THROUGH F9 ARE NOT FURNISHED WITH THE 91455 PANEL AND MUST BE ORDERED SEPARATELY. THE STANDARD SIZE FOR THE 9004B CHANNEL BANK (F1 THROUGH F6) IS 7-1/2 AMPERES. THE MAXIMUM SIZE FOR F9 IS 1-AMPERE. THIS LIMIT IS IMPOSED BY THE RATING OF THE DIODES THAT ISOLATE THE A AND B SUPPLIES.

FUSE RATING AMPERES	COLOR	PART NO. 175-28996-
0.18	YELLOW	-04
1/4	VIOLET	-05
1/2	RED	-09
3/4	BROWN	-06
1	GREY	-01
1-1/3	WHITE	-02
2	ORANGE	-03
3	BLUE	-07
5	GREEN	-10
7-1/2	BLACK-WHITE	-12

2. FUSE COVER. FUSES SHOULD BE EQUIPPED WITH A PLASTIC FUSE COVER, PART NO. 122-71501-01.

3. TERMINAL BOARD TB1. IF SEPARATE A AND B POWER DISTRIBUTION IS USED, REMOVE THE U-LINK JUMPER (PART NO. 137-56660-03) BETWEEN TB1-3 AND TB1-4. FOR SEPARATE GROUNDS, REMOVE THE U-LINK FROM BETWEEN TB1-1 AND TB1-2.

4. RELAYS. RELAYS K1 AND K2 ARE PLUG-IN RELAYS. THEY ARE SHOWN IN THEIR NORMAL OPERATING STATE:
   K1 DE-ENERGIZED
   K2 ENERGIZED

Figure 5. 91455 Fuse and Alarm Panel Circuit Diagram (Sheet 1 of 2).

Figure c. System Alarm Outputs at ACUs.

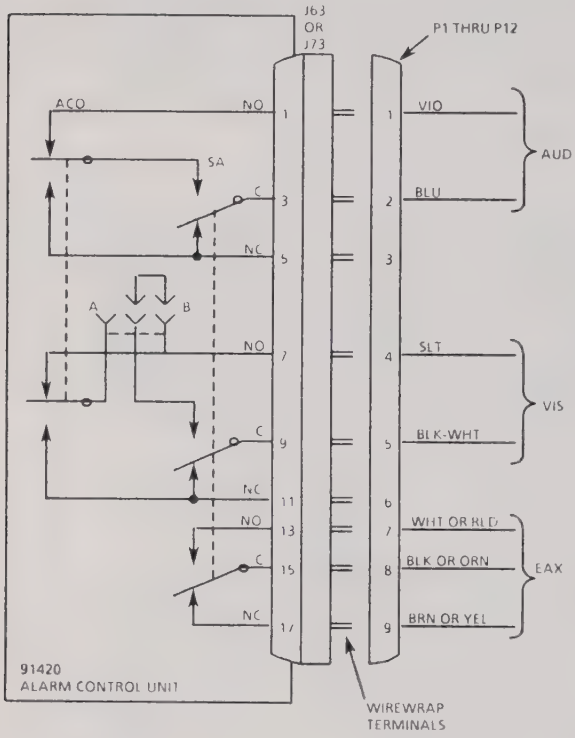
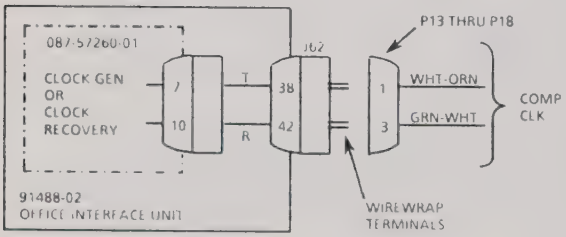


Figure d. Composite Clock Input/Output at OIUs.



NOTE: FIGURES C AND D ARE PART OF THE 91430 SHELF

Figure e. Alarm and Clock Busing Through Wiring Harness 088-91006-XX.

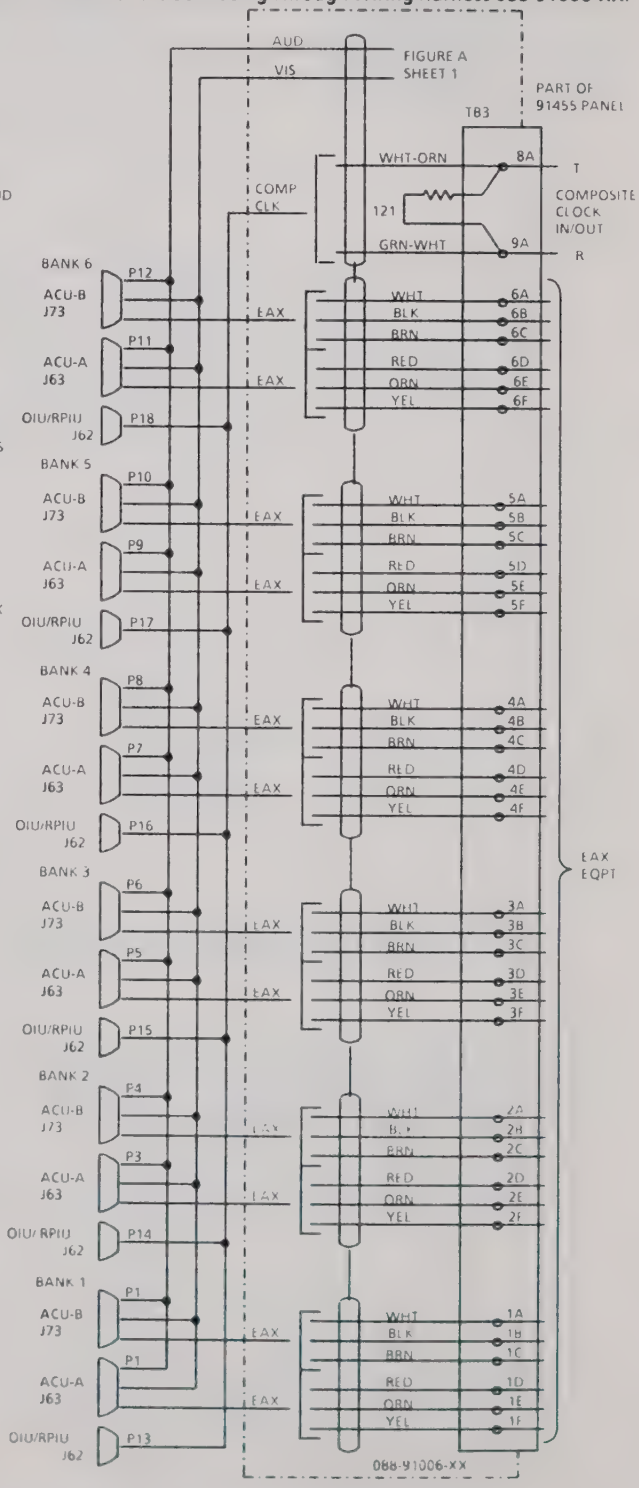


Figure 5. 91455 Fuse and Alarm Panel Circuit Diagram (Sheet 2 of 2).

2.14 **System Alarm.** Three sets of form-C dry contacts on the system alarm relay in the 91420 Alarm Control Unit (ACU) appear on receptacle connectors J63 (91420 ACU A) and J73 (91420 ACU B) of the 91430 shelf. The three sets are assigned to the audible, visual, and EAX alarm functions.

2.15 If the rack assembly has a 91455 Fuse and Alarm Panel, the alarm contacts can be extended from the 91420 ACU to TB3 on the 91455 panel with wiring harness 088- 91006-XX as shown in Figure 4g. Audible and visual alarm contacts are multipled between 91420 ACUs; EAX alarm contacts are separate for each 91420 ACU. Office alarms are assigned to terminals on TB3 as follows:

- Audible alarm to 7A, 7B, and 7C (Figure 4b).
- Visual alarm to 7D and 7E (Figure 4b).
- EAX alarms to terminals A through F in columns 1 through 6 (Figure 4g).

2.16 The wiring harnesses have 10-contact female connectors that plug onto the left-hand vertical row of wirewrap terminals on J63 and J73. Contacts 1 through 10 mate with odd-numbered terminals 1 through 19 as shown in Figures 4c, 4d, and 5c.

2.17 **Composite Clock.** As shown in Figure 5e, wiring harness 088-91006-XX includes a composite clock distribution circuit used in digital data applications. A single pair is multipled between three-contact female connectors that plug onto wirewrap terminals of J62, the receptacle connector for the 91448-02 OIU/91419-02 RPIU. As shown in Figure 4e and Figure 5d, female connector contacts 1 and 3 mate with J62 terminals 38 and 42 in the right-hand row. The pair terminates in 121 ohms at TB3, terminals 8A and 9A, on the 91455 Fuse and Alarm Panel.

2.18 **Wiring Harness Installation.** The breakouts from wiring harnesses 088-91006-01 through -04 are spaced for standard rack assemblies (Practice 342-911-133) having a 91455 panel at the top of the rack and up to six channel banks. Wiring harness 088-91006-08 has breakouts for a 91455 panel near the middle of the rack and five channel banks. Refer to Figure 6.

2.19 If a rack assembly has fewer channel bank positions, the excess harness may be cut off. Audible alarm, visual alarm, and composite clock leads, which are multipled between connectors, should be insulated and tied back at the cutoff. Unused EAX alarm leads should be tied back at each end.

CAUTION

INSTALL THE WIRING HARNESS AND CONNECT THE OFFICE WIRING BEFORE YOU APPLY POWER TO THE 91455 PANEL.

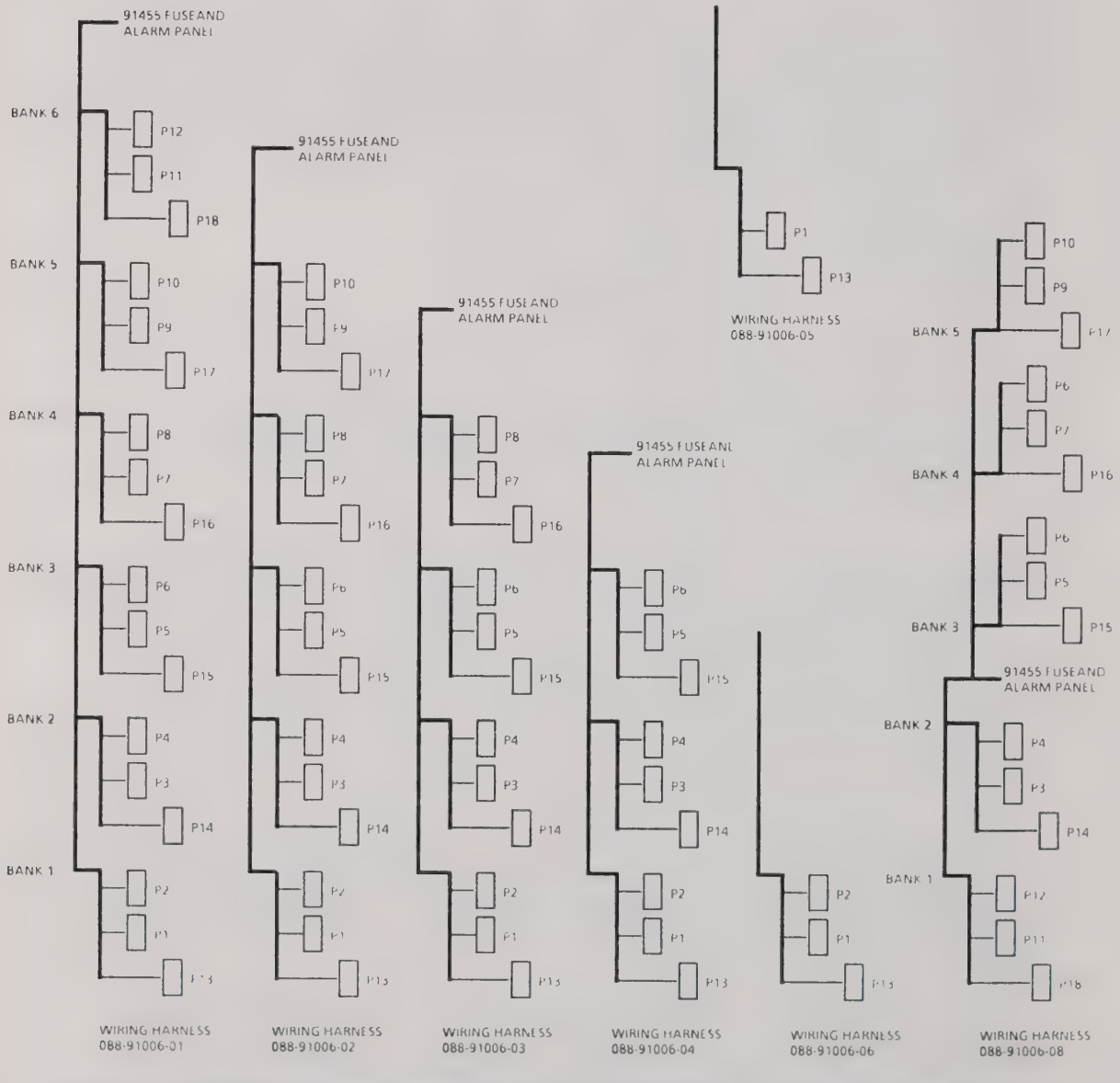


Figure 6. Wiring Harnesses for System Alarm and Composite Clock Distribution.

2.20 Wirewrap the 24 AWG wiring harness leads to the 0.045-inch square terminals on TB3 of the 91455 panel as shown in Figure 5e. After the harness has been installed, office alarm leads should be wirewrapped on the same side of TB3. Unplug relay K2 temporarily to silence the office alarms.

2.21 Field wirewrapping to the 0.025-inch square terminals on J62, J63, and J73 is not recommended. For nonstandard rack configurations, wiring harness 088-91006-06 has three connectors to access the OIU and 91420 ACU's of one channel bank. This -06 wiring harness is recommended for all modes. Wiring harness 088-91006-05, which has two connectors for access to the 91448 OIU and 91420 ACU (A) of one channel bank, is recommended for mode 1 only. Wire leads are 24AWG solid, 12 feet long.

2.22 Wiring harnesses may be fabricated locally from 24AWG wire, connector bodies 140-54174-XX, and contacts 140-54175-XX. Refer to Figure 7. A crimping tool, Molex Part No. HTR-2445A, is recommended for attaching wires to the contacts. If the tool is not available, crimping can be done with needle-nose pliers.

2.23 **Fuse Alarm.** Fuse alarm relay K1 on the 91455 panel has two sets of form-C dry contacts accessible at terminal row 10 on TB3 (Figure 5a). The wirewrap terminals are 0.045-inch square. Fuse alarm relay K1 on the 91436 Power Distribution Unit (PDU) of the channel bank has one set of form A dry contacts accessible at J50 as shown in Figure 4f. The wirewrap terminals on J50 are 0.032 x 0.062 inch.

Supervisory System

2.24 Where applicable, the interface with an external supervisory system is made at 10 wirewrap terminals on J62, the receptacle connector for the 91448 Office Interface Unit (OIU). Remote control inputs to each digroup are Ext Loop and Ext ACO; supervisory outputs are Ext Loc Alm and Ext Rem Alm from each digroup, Ext Pwr Alm, Ext Loop Ind, and Degraded Performance alarm (RPIU only). Refer to Figures 4e and 4f.

2.25 Field wirewrapping to the 0 .025-inch square terminals on J62 is not recommended. Connections should be made with three-contact and four-contact female connectors as shown in Figure 4e. Refer to Figure 7 for connector assembly instructions.

RS-232-C Port Connections

2.26 When the 91419 RPIU is installed (instead of the 91448 OIU), an ASCII serial RS-232-C interface terminal is normally connected to J62. Connect the local or remote RS-232-C terminal to the J62 connector terminals listed in Table 3. Field wirewrapping to the 0 .025-inch square terminals on J62 is not recommended. Connections should be made with a female connector body, Part No. 140-54174-XX, and contacts, Part No. 140-54175-XX. Refer to Figure 7 for connector assembly instructions.

RS-422 Port Connections

2.27 When the 91419 RPIU is installed (instead of the 91448 OIU), an RS-422 port is provided for TBOS (Telemetry Byte Oriented Serial) interface for remote telemetry. Connect the RS-422 interface to the J62 connector terminals listed in Table 3. Field wirewrapping to the 0 .025-inch square terminals on J62 is not recommended. Connections should be made with a female connector body, Part No. 140-54174-XX, and contacts, Part No. 140-54175-XX. Refer to Figure 7 for connector assembly instructions.

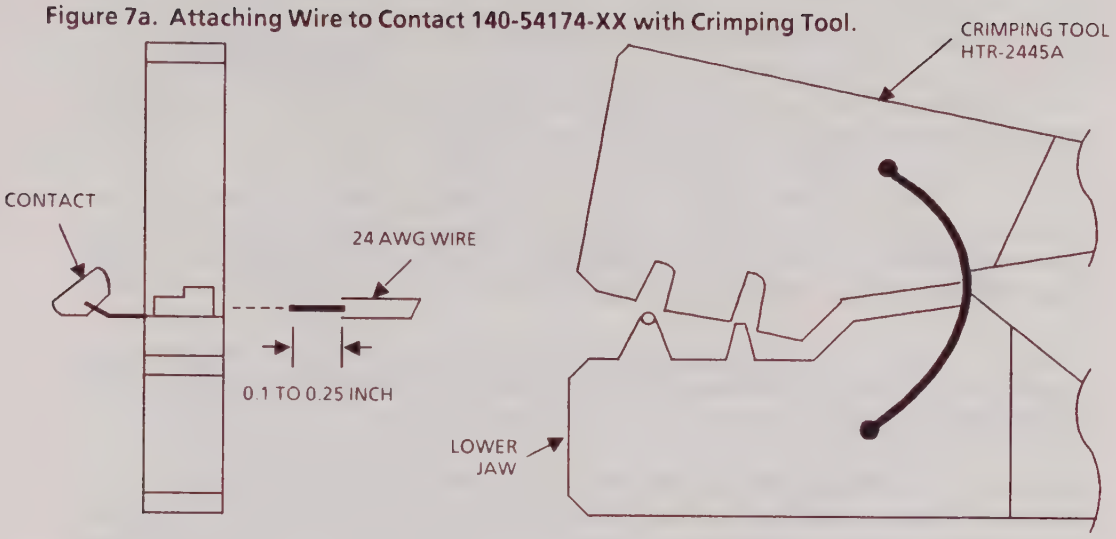
Table 3. RS-232-C Port and RS-422 Port Connections.

SIGNAL	SIGNAL NAME	J62	CONNECTION FOR
TXD 232	Transmit Data (TD)	17	RS-232-C Local and Remote (Modem)
RXD232	Receive Data (RD)	18	RS-232-C Local and Remote (Modem)
SGND	Signal Ground	19	RS-232-C Local and Remote (Modem)
RTS232	Request to Send (RTS)	20	Remote (Modem) Only
CTS232	Clear to Send (CTS)	21	Remote (Modem) Only
DSR232	Data Set Ready (DSR)	22	Remote (Modem) Only
DCD232	Data Carrier Detect (DCD)	23	Remote (Modem) Only
DTR232	Data Terminal Ready (DTR)	24	RS-232-C Local and Remote (Modem)
TXD422A	Transmit Data A (TD-A)	25	RS-422
TXD422B	Transmit Data B (TD-B)	26	RS-422
RXD422A	Receive Data A (RD-A)	27	RS-422
RXD422B	Receive Data B (RD-B)	28	RS-422
SGND422	Signal Ground	K	RS-422

NOTES:

1. For RS-232-C modem interface, use 1200 Baud, 8 Data Bits, 1 Stop Bit, and No Parity.
2. For RS-422A modem interface, use 2400 Baud, 8 Data Bits, 2 Stop Bits, and No Parity.

Figure 7a. Attaching Wire to Contact 140-54174-XX with Crimping Tool.



NOTES:

1. Connector Body Information:

No. of Con. Pos.	Part No.	Molex Part No.
3	140-54174-04	09-50-7031
4	140-54174-03	09-50-7041
6	140-54174-08	09-50-7061
10	140-54174-06	09-50-7101

2 Contact Identification:

Wire, AWG	Part No.	Molex Part No
24 or 26	140-54175-01	08-56-0108
18, 20, or 22	140-54175-02	08-56-0106

3 Polarizing Plug. When required, a nylon plug may be inserted in an unused contact position for connector polarization. Part No 140-54174-10; Molex Part No. 15-04-0219.

4. Attaching Wire to Contact per Figure 7a:

(a) Operation of the crimping tool is easier if the tool's lower jaw is clamped in a vise

(b) Squeeze tool handles fully closed to release ratchet so that jaws can be opened

(c) Strip wires 0 1 to 0 25-inch

(d) Use a 140-54175-01 contact for one 24 AWG wire or a -02 contact for two 24 AWG wires.

(e) Place contact between jaws as shown in Figure 7a. Slowly squeeze handles so that contact is lightly held in tool

(f) Insert wire end in contact so that insulation will be gripped by the rear tabs and the conductor will be gripped by the forward tabs

(g) While maintaining the wire in position, crimp the tabs by squeezing the handles fully closed.

(h) Remove contact from the tool and inspect for crimping

5. Inserting Contact in Connector Body:

(a) Connector contacts are numbered from top to bottom with No. 1 at the top. Contact No. 1 should be marked on the connector body

(b) Wirewrap terminals are numbered from top to bottom with odd numbers in the left-hand vertical row and even numbers in the right-hand vertical row.

(c) Orient the connector body and contact as shown in Figure 7b. Note that the orientation is opposite for the left-hand and right-hand vertical rows of wirewrap terminals.

(d) Insert the contact so that the locking tab engages the notch in the connector body.

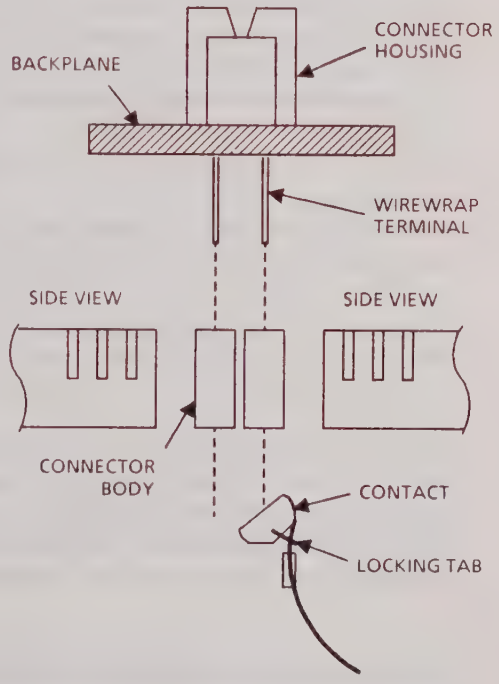


Figure 7b. Inserting Contact 140-54175-XX in Connector Body 140-54174-XX, Top View.

Figure 7. Female Connectors that Plug onto Wirewrap Terminals on the Backplane; Assembly Instructions.

Digital Lines

2.28 If the channel bank is to operate in Mode 3, connect the DS1 cable pairs of digroup A and digroup B to J66 and J76 as shown in Figure 4b. These are 0.045-inch square wirewrap terminals. For channel bank Mode 1 or 2, connect the DS1C cable pairs to J66.

2.29 As an alternative to wirewrapping, cable pairs can be terminated in a six-contact connector that plugs onto J66 or J76. Use connector body 140-54174-08, five contacts 140-54175-02, and polarizing plug 140-54174-10 in the unused contact position. See Figure 7.

2.30 The 91430-01 Channel Bank Shelf will comply with FCC Part 15, Subpart J Class A requirements if and only if cable installation kit 970-91430-01 is utilized during installation of the system.

2.31 To install the 970-91430-01 installation kit, locate the T1 pins on the wirewrap termination points J66 and J76 found on the extreme upper left of the backplane. Single pair shielded cables will be terminated on pins 3 and 4 and 5 and 6 of J66, and pins 1 and 2 and 5 and 6 of J76. Before terminating these T1 cables, they must be looped four times through the ferrite core Part No. 130-29371-17. Terminate the cables as usual. The ferrite core must not be allowed to come in contact with any uninsulated wires or pins, and should not be allowed to protrude from the backplane any more than necessary.

2.32 The eight VF cable adapters consist of plug ended cables which are looped through a ferrite core. Four are designed to exit left, Part No. 035-91430-03, and four to exit right, Part No. 035-91430-04. These must be installed "in-line" with the entering VF cables at the backplane.

2.33 The female connector is plugged in to the shelf connector after routing through the grommetted cutouts on the side panels. The ferrite cores will remain outside the side panels.

2.34 The battery and ground leads which terminate on TB1 (lower left corner of the backplane) must be looped four times through the ferrite core, Part No. 130-29371-29, and terminated as usual at the proper battery and ground lugs on TB1. As previously noted, the ferrite core must be positioned in such a manner to prevent any electrical shorts.

2.35 Peel the backing paper from the FCC compliance label and affix the label to an easily visible portion of the left side panel. For information regarding the FCC Part 15, Subpart J compliance, see Practice 342-911-050.

VF and Signaling/Supervisory Circuits

2.36 The office interface with the channel unit VF and signaling/supervisory circuits is made at 50-pin receptacle connectors J101-J104 (digroup A) and J201-J204 (digroup B). Refer to Figure 4a.

Connections are made through Cable Assembly Part Nos. 163-10315-XX or 163-10316-XX or through locally-fabricated cable assemblies. For information on connector pin assignments and cable color codes, refer to Practice 342-911-133.

NOTE: Figure 4a is a rear view of the 91430-01 shelf. The 91430-11 shelf has two additional 50-pin connectors: J105 (between J103 and J104) and J205 (between J203 and J204).

2.37 The shelf-mounted receptacle connector and the plug connector on the cable assembly are secured in the mated position in one of the following ways:

- **Plug Connector Manufactured by Amphenol or TRW-Cinch.** Fasten the plug connector at one end with a #4-40 screw into the tapped hole in the shelf connector bracket. Secure the other end with a cable tie looped through two untapped holes in the shelf connector bracket. A suitable nylon cable tie, 7 inches long, is identified by Part No. 137-49389-01.

- **Plug Connector Manufactured by AMP.** A locking clip, AMP Part No. 552723-1 or Siemens Communication Systems Part No. 120-56786-01, is required. Eight clips are furnished in a cloth bag with the shelf. Before the connectors are mated, place the clip on the shelf receptacle connector at the outboard end so that the tabs on the clip enter the slots in the connector body. To release mated connectors, push the clip in against the connector body at the end.

2.38 On each shelf level, an FDM TMB wirewrap terminal is bused to pin 20 of the 12 channel units on the same level. These circuits are for applications that use 91434-01 4W SF Channel Units back-to-back with an FDM channel bank. The wirewrap terminals are 0.045 inch square.

Strapping Plugs

2.39 Strapping plugs Part Nos. 141-56699-01 (single-pole) and -02 (double-pole) are white nylon with 0.020 x 0.030 inch contact pins on 0.1-inch centers. They are inserted in sockets on the shelf and units according to selected strapping options. If a socket has two optional positions for the strapping plug, one position is identified by a raised boss marked in white.

2.40 Strapping plug 140-56463-01 is black polyester with single-pole female contacts on 0.1-inch centers. It is used on the shelf to connect a pair of 0.025-inch square wirewrap terminals at each channel unit position.

2.41 Strapping plug 140-56464-01 is blue polyester with single-pole female contacts on 0.1 inch centers. It is used on the transmit unit, 91426 Syndes Unit, and 91448 OIU.

2.42 The cloth bag furnished with the shelf includes an extra strapping plug for each type used on the shelf and an extraction tool, (Part No. 020-56788-01) used with the 141-56699-01 and -02 plugs.

Terminal Equipment Shelf Strapping

2.43 Strapping plugs on the back of the shelf are positioned according to channel bank mode, channel sequence (D1D, D2, or D3), and channel unit busy requirements as described in following paragraphs. As shipped from the factory, the shelf is strapped for Mode 3, D3 sequence, and channel unit busy as shown in Figure 4.

2.44 **Receive Signal**. From the RCV A input terminals, the PCM signal goes through socket J67 to an 91427 LIU (Mode 1), 91426 Syndes Unit (Mode 2), or receive unit (Mode 3). To close the signal path, insert a double-pole strapping plug (Part No. 141-56699-02) in the applicable position of J67, MODE 1-2 or MODE 3. Refer to Figure 4b.

2.45 **Alarm Circuits.** The channel bank has one 91420 ACU in Mode 1 and two 91420 ACU's in the other modes. Insert strapping plugs in the applicable position of J90 through J93: MODE 1 or MODE 2,3,4. Three double-pole strapping plugs (Part No. 141-56699-02) and three single-pole strapping plugs (Part No. 141-56699-01) are required. Refer to Figures 4c and 4d.

2.46 As reference information, alarm circuits affected by strapping are listed below in the order in which they appear. For example, on J90, AC5' is at pins 1-2-3 and AC7 is at pins 4-5-6. Pin 1 is the upper pin.

ALARM CIRCUITS	STRAPPING PLUG
AC5', AC7	J90
AC4', AC3, AC1	J91
AC2', AC6	J92
TMB1', TMB2'	J93

2.47 **Channel Sequence**. The channel sequence can be assigned independently in each digroup. Insert a single-pole strapping plug (Part No. 141-56699-01) in the applicable position of J74 (DIGROUP B) and J64 (DIGROUP A). Refer to Figures 4c and 4g.

2.48 **Channel Unit Removal**. When a channel unit is unplugged from the shelf, switching contacts on the shelf receptacle connector close pin 41 to 42 and pin 43 to 44. If the trunk is to be made busy when the channel unit is removed, a single-pole strapping plug (Part No. 140-56463-01) is installed so that ground is applied to a C lead or E lead on pin 43 or a C1 lead on pin 40. Optional strapping arrangements are as follows:

- **Ground Required on a C Lead or E Lead at Pin 43.** Install the strapping plug between pin 44 and the adjacent terminal A. However, for channel units 1A, 13A, 1B, and 13B, install the strapping plug between the two terminals A's. These are the factory-installed strapping plug positions shown in Figure 4h.

- **Ground Required on C1 Lead at Pin 40.** Install the strapping plug between pin 41 and the adjacent terminal B.

NOTE: In certain channel unit applications, pin 44 is assigned a signaling/supervisory function and should not be grounded. In these cases, if the above procedure does not apply, install the strapping plug so that it makes connection only with terminal B. This is a nonfunctional "parking" position.

2.49 For information on the signaling/supervisory leads at pins 40 and 43, refer to the appropriate channel unit Practice listed in Table 2.

Common Equipment Strapping

2.50 Strapping options for the common equipment plug-in units are summarized in Figure 8 and described in the following paragraphs.

2.51 **91420 Alarm Control Units.** The system alarm relay of the 91420 ACU has three form-C dry contacts dedicated to office alarm circuits as shown in Figure 5c. In a system alarm condition, operation of the ACO relay disables the audible alarm, but has no effect on the EAX alarm. The visual alarm may be disabled or not according to the position of the A/B strapping plug.

2.52 **91438 Transmit Units.** The digroup transmit timing source in Mode 2 or 3 is selected by two strapping plugs on the 91438 Transmit Unit. Selection must be coordinated on a system basis; for example, the looped receive clock option cannot be used at both ends of a system. In Mode 1, the timing source is in the 91427 Line Interface Unit and the 91438 Transmit Unit strapping has no effect.

2.53 If the channel bank signaling function is not used, the 91438 Transmit Units should be strapped so that bit 8 of frames 6 and 12 is not reserved for signaling.

2.54 **91439 Receive Units**. There are no strapping options for the 91439 Receive Units.

2.55 **91427 Line Interface Unit.** The digroup transmit timing source in Mode 1 is selected by two strapping plugs on the 91427 LIU. As explained previously, selection is a system consideration.

2.56 **91426 Syndes Unit.** In a 9004B channel bank, the three A/B strapping plugs on the 91426 Syndes Unit must be in position B. (The Model 1 unit cannot be used in the 9004B bank.)

Figure 8. Common Equipment Strapping Options (Sheet 1 of 2).

Unit	Option		Strapping Plug		
			Name	Position	Part No. (Qty.)
Alarm Control Unit	ACO Disable Visual Alarm	Yes	A/B	A	141-56699-01 (1)
		No		B	
Transmit Unit 91438	Transmit Timing Source (Mode 2 or 3)	Internal Clock	EXT CLK LP CLK	O* O*	140-56464-01 (3)
		External Clock	EXT CLK LP CLK	I Either	
		Looped Receive Clock	EXT CLK LP CLK	O I	
	Channel Signaling via Bit 8	Yes	SIG	I*	
		No		O	
Line Interface Unit (Mode 1)	Transmit Timing Source	Internal Oscillator	EXT CLK LOOP TIME	OUT* OUT*	141-56699-01 (2)
		External Clock	EXT CLK LOOP TIME	IN Either	
		Looped Receive Clock	EXT CLK LOOP TIME	OUT IN	
Syndes Unit (Note 1) (Mode 2)	Channel Bank Type	9004A	A/B	A	140-56464-01 (3) (Note 2)
		9004B		B*	
Office Interface Unit 91448-01 or -02	Supervisory Scan Cycle	Less than 2.5 seconds	SCAN	F*	140-56464-01 (1)
		2.5 to 25 seconds		S	
91448-02 OIU OR 91419-02 RPIU	Channel Bank Mode	Mode 1	G, I, K, Q		140-56464-01 (11)
		Mode 2 or Mode 3	H, J, L, R*		
	Composite Clock Source	Internal	A, C, M, O, S		
		External	B, D, N, P, T*		
	Internal Clock Synch	Digroup A	V*		
		Digroup B	U		
	Composite Clock Input	Bridging	E*		
		Terminating	F		

* Factory Strapping

NOTES:

1. A Model 1 Syndes Unit cannot be used in the 9004B Channel Bank
2. Install the three strapping plugs on the Syndes Unit as shown at right

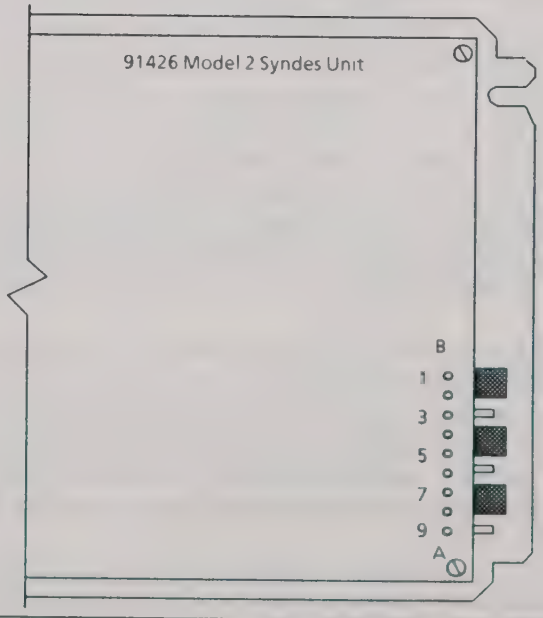


Figure 8. Common Equipment Strapping Options (Sheet 2 of 2).

Unit	Option		Strapping Plug		
			Name	Position	Pins Shorted
91418 TREU	Transmit Timing Source (Mode 3)	Internal Clock	EXT CLK LP CLOCK	O* O*	2nd and 3rd 5th and 6th
		External Clock	EXT CLK LP CLK	I O*	1st and 2nd 5th and 6th
		Looped Receive Clock	EXT CLK LP CLK	O* I	2nd and 3rd 4th and 5th
		B8ZS	B8ZS B7Stuffing	I* O	7th and 8th 8th and 9th
	Channel Signaling		ESF SIG ENB	IN OUT* IN* OUT	1st and 2nd 2nd and 3rd 4th and 5th 5th and 6th

* = Factory Setting

SW1 Three-Position Dipswitch LBO Cable Length Selection Table

CABLE LENGTH	LBO1	LBO2	LBO3
0-110 Feet*	Closed	Closed	Closed
110-220 Feet	Open	Closed	Closed
220-330 Feet	Closed	Open	Closed
330-440 Feet	Open	Open	Closed
440-550 Feet	Closed	Closed	Open
550-660 Feet	Open	Closed	Open
Invalid	Open	Open	Open

NOTES:

1. There are seven U-link straps on the 91418 TREU. They are identified as STRP 1 through STRP 7. Do not move these straps. They are primarily used in the factory for test purposes.
2. When ESF is Out (O), the 91418 TREU is strapped for superframe format.
3. When the B8ZS strap is Out (O), the 91418 TREU is strapped for AMI (B7 stuffing) coding.
4. Refer to Figure 4 for backplane strapping on the 91430 shelf

2.57 **91418 Transmit and Receive Extended Superframe Unit.** Strapping plugs for this unit are provided on the front panel and on the card. The digroup transmit timing source is selected by two strapping plugs on the front panel of this unit. Selection must be coordinated on a system basis; for example, the looped receive clock option cannot be used at both ends of a system. A front panel strap is also provided for selecting B8ZS operation. Line Build-Out equalization dipswitches are located on the card.

2.58 **91419-01 Remote Performance Interface Unit.** There are no strapping options on the 91419-01 Remote Performance Interface Unit.

2.59 **91419-02 Remote Performance Interface Unit.** The 91419-02 RPIU has four strapping options involving 11 strapping plugs. Strapping this unit is a system consideration. The 91419-02 RPIU must be removed from the shelf to reach the 11 strapping plugs: A/B, C/D, and so forth through U/V.

2.60 **91448 Office Interface Unit**. An external supervisory system may monitor LOC and REM alarm indications in each digroup through the 91448 OIU. An alarm indication is retained in the 91448 OIU until the alarm clears, but for at least 2.5 or 25 seconds, according to the SCAN strapping plug position. This delay ensures that short-duration alarms between successive scans by the supervisory system do not escape detection.

2.61 For the 91448-01 OIU, the SCAN strapping plug is accessible without unplugging the OIU. It has two positions: F for a fast scan (less than 2.5 seconds) and S for a slow scan (2.5 to 25 seconds).

2.62 For the 91448-02 OIU, the SCAN strapping plug is also accessible without unplugging the OIU. It also has two positions: F for a fast scan (less than 2.5 seconds) and S for a slow scan (2.5 to 25 seconds). The 91448-02 OIU, which is used in certain digital data applications, has four additional strapping options involving 11 strapping plugs. Strapping this unit is a system consideration. The 91448-02 OIU must be removed from the shelf to reach the 11 other strapping plugs: A/B, C/D, and so forth through U/V.

2.63 Generally, the 91448-02 OIU's are bridged on the composite clock distribution circuit, which is terminated in 121 ohms on the 91455 Fuse and Alarm Panel. If the rack assembly does not have a 91455 panel, the circuit can be terminated in an OIU by inserting the E/F strapping plug in position F. (Of course, the termination is lost if the OIU is unplugged, as a troubleshooting step for example.)

Channel Unit Strapping

2.64 Install or verify strapping according to the instructions in the appropriate channel unit Practice listed in Table 2. In addition to VF and signaling/supervisory strapping options, channel units have strappable attenuators and Network Buildout (NBO) capacitors as follows:

- All VF channel units have six-section transmit and receive attenuators with values of 0.1, 0.2, 0.4, 0.8, 1.6, and 3.2 dB. This provides an adjustment range of 0 to 6.3 dB in 0.1-dB steps. A strapping plug must be inserted in the IN or OUT position of each section.

- Four-wire channel units have tandem transmit and receive attenuators with three or more possible values (including 0 dB). A strapping plug must be inserted in one of the positions.

- Most two-wire channel units have six NBO capacitors for compensating capacitance on the two-wire drop between 0 and 0.126 uF (126 uF) in 0.002-uF steps. Capacitance is added by inserting the strapping plug in the position adjacent to the value marked in uF: 2, 4, 8, 16, 32, and 64. Positions marked "0" are for parking the strapping plug when the capacitance is not required.

NOTE: On some channel units, dipswitches are used in place of strapping plugs.

Unit Installation or Removal

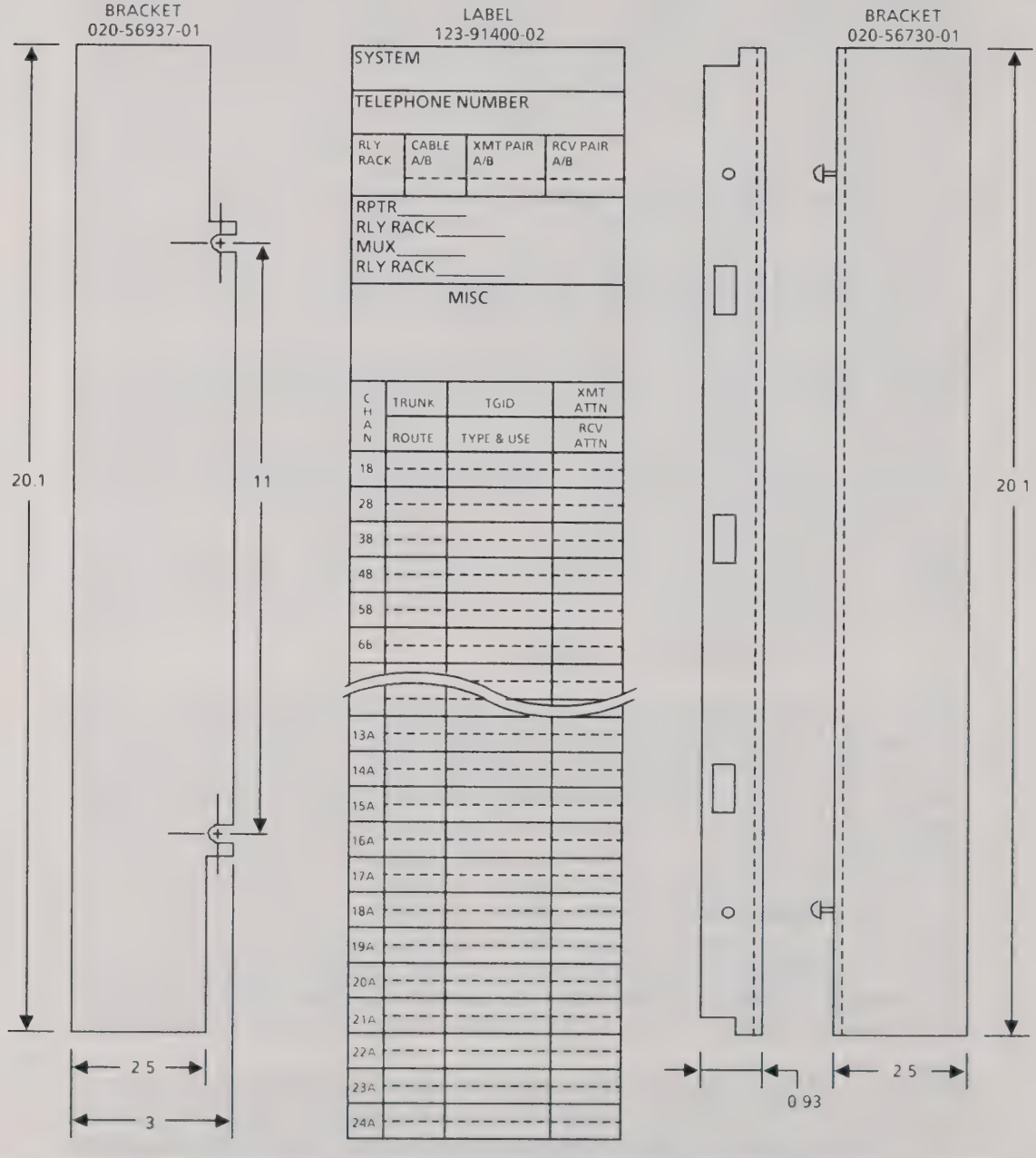
2.65 Plug-in units on each of the four shelf levels are secured at the bottom by a plastic locking bar. To install or remove a unit, slide the locking bar to the right. Most common equipment units have an extractor lever to facilitate disengaging the unit from the shelf receptacle connector. On the channel units, the faceplate serves as a handle for this purpose.

Channel Assignment Label

2.66 Information about channel assignments should be recorded on the label (Part No. 123-91400-02) illustrated in Figure 9. The label is adhesive-backed white vinyl with a matte writing surface.

NOTE: To measure transmission levels with the 91232 or 91442 test set, channel unit transmit and receive attenuator settings must be known. The right-hand column of the channel assignment label provides a convenient place to record this data.

2.67 The label attaches to either of two brackets as shown in Figure 9. One bracket (Part No. 020-56730-01) mounts in the keyhole slots on the left or right side plate of the shelf. The other bracket, used when the shelf is mounted on the rear of an unequal-flange duct type rack, attaches to the left or right vertical channel of the rack.



NOTE: DIMENSIONS ARE IN INCHES

Figure 9. Channel Assignment Label.

Cabling for 91418 Transmit and Receive Extended Superframe and 91419 Remote Performamce Interface Units

2.68 Two interface cables are supplied with the 91419 RPIU. During initial power-up, the cables are installed between the 91419 RPIU and each 91418 TREU. These 20-pin cable connections to the 91418 TREU for each digroup provide the interface for the 91419 RPIU to periodically gather data such as loss of signal, out of frame and alarm signal conditions, CRC block errors, and the number of bipolar violations. With power off, it does not matter which cable is connected or disconnected first. But if power has been applied, first disconnect the cables connected to the 91419 RPIU before disconnecting them from either of the 91418 TREUs. This disconnect procedure eliminates any reporting or storage of misleading alarm messages.

Initial Power-Up

2.69 After the equipment has been mounted and wired, power up and insert the plug-in units as follows:

(a) To install the 91436 Power Distribution Unit, first remove TALK BAT fuses A and B per the front panel CAUTION. Then, insert the unit at the lower right-hand corner of the shelf.

(b) Install the 91425 Power Supply Unit (PSU) in the upper right-hand corner of the shelf.

(c) On the 91455 Fuse and Alarm Panel, install a 7.5-ampere GMT-type fuse (Part No. 175-28996-12, black-white code) in the appropriate fuseholder; fuses F1-F6 are for channel banks 1-6.

NOTE: GMT-type fuses should be equipped with a plastic fuse cover, Part No. 122- 71501-01.

(d) Insert TALK BAT fuses removed in step (a) above.

(e) Measure DC voltages at test points on the 91425 PSU as described in paragraph 6.14.

(f) Insert the common equipment units into the shelf in the following order. Verify that all of the plug-in units (except the receive units) have been properly strapped.

NOTE: If the channel bank is in operational Mode 2 or 3, but only one digroup is to be turned up for service, do not plug in the 91420 ACU for the inactive digroup. To do so will result in misleading alarm indications.

(1) Insert the 91426 Syndes unit (Mode 2) or 91427 LIU (Mode 1) in the SYN/LIU position. This position is unoccupied in Mode 3.

(2) Insert the 91420 ACU in the 91420 ACU (A) position.

(3) Insert the 91420 ACU in the 91420 ACU (B) position (Mode 2 or 3). This position is unoccupied in Mode 1.

NOTE: Either digroup may be turned up first.

(4) Insert the optional 91448 OIU or the optional 91419 RPIU in the OIU position.

NOTE: Perform steps (5) through (8) only if the 91419 RPIU is installed and if an ASCII terminal is connected to the RS-232-C port.

(5) Depress the RPIU RESET pushbutton on the 91419 RPIU.

(6) At the ASCII terminal connected to the RS-232-C port, enter the ADMIN mode. Refer to Practice 342-911-550.

(7) At the ASCII terminal connected to the RS-232-C port, use the ERASE command to clear the non-volatile memory and then perform a system RESET. Refer to Practice 342-911-550.

(8) At the ASCII terminal connected to the RS-232-C port, use the THRESHOLD command to set the performance monitor thresholds (or use the default parameters instead). If desired, use the DATE and TIME commands to set the correct date and time. Refer to Practice 342-911-550.

(9) Insert the 91438 Transmit Unit or the 91418 TREU in the XMT position of each digroup to be equipped.

(10) Insert the 91439 Receive Unit in the RCV position of each digroup to be equipped. Note that no 91439 Receive Unit is installed if the 91418 TREU is installed in step (9).

(11) If the 91419 RPIU is installed in step (4), connect the two cables that are supplied with the RPIU. Install the cables between the 91419 RPIU and each 91418 TREU.

(12) If the 91419 RPIU is installed and if the ASCII terminal is connected to the RS-232-C port, use the CONFIG command to set the configurable options. Refer to Practice 342-911-550.

(g) Measure DC voltages at test points on the 91425 PSU according to paragraph 6.15.

(h) This step is optional. With all the common units installed, use a TEKELEC Model TE820A DS1 Frame Simulator-Analyzer or equivalent and perform a check on the DS1 signal for each digroup. Perform the check at the cross-connect panel. Check all configurations of the signal (ESF and SF formats, with/without B8ZS etc). Refer to the TEKELEC manual for more information.

(i) Insert the channel units into the shelf. The units should be properly strapped and, if applicable, the attenuator settings recorded on the channel assignment label at the side of the shelf.

(j) Measure DC voltages at test points on the 91425 PSU according to paragraph 6.15.

2.70 Proceed to the installation-phase performance tests listed in Figure 10.

3. MAINTENANCE

3.01 Part 3 provides background information for the test procedures of Parts 4 and 5 and the troubleshooting procedures of Part 6.

Test Equipment

3.02 For complete testing capability, the test equipment items listed in Table 4 are required. Another item may be substituted if it has suitable accuracy and fully performs the required test functions.

3.03 In the channel performance tests, test equipment is patched to miniature telephone-type jacks on the 91442 VF Test Set or the 91232 Test and Alignment Set. The connection is made through the tip and ring of the jack; the sleeve is grounded. A transformer in the test set provides impedance matching and isolation between the unbalanced 600-ohm test equipment and the balanced 600-ohm or 900-ohm VF channel circuits. Levels can be read directly in dBm and dBrnc without applying a correction factor to the meter reading.

3.04 Meters are operated in the terminating mode with the 91442 test set and in the bridging mode with the 91232 test set. (The bridging mode is specified for crosstalk measurements with the 91442 test set.)

Controls and Indicators

3.05 The functions of controls and indicators on the channel bank are described in Table 5.

Figure 10. List of Performance Tests.

Channel Bank Mode	Procedure			Recommended (X)						
	Name	Figure Using		Installation	Routine Maintenance (Note 4)	Unit Replacement (Note 5)				
		91442 Test Set	91232 Test Set			Trnsmt Unit (Note 7)	Rcv Unit (Note 7)	Alarm Control Unit	Syndes Unit or LIU	Channel Unit (Note 3)
Looped	VF Level	20	24	X			X		X	
	Idle Noise	20	24	X		X	X		X	
	Distortion	20	24	X		X	X		X	
End-to-End (Note 1)	VF Level	21	25		X					X
	Idle Noise	21	25		X					X
	Distortion	21	25		X					X
	Impulse Noise	21	25	X	X					X
	Frequency Response	22	26	X						X
	System Alarm Restoral (Note 2)	29		X				X		
	Dial Pulse Signaling Distortion	See applicable Practice listed in Table 2.		X						X
	Crosstalk (Note 6)	23	27							

NOTES:

1. System Configuration. The end-to-end procedures in this Practice are specifically for systems between 9004A/B channel banks However, if the equipment at one end is not 9004A/B, end-to-end operation should be satisfactory if the channel bank at each end meets the looped test requirements
2. System Alarm Restoral. The process by which the channel banks at each end of a system restore from an alarm condition is referred to as "simultaneous restoral" or "coordinated restoral."
3. Channel Unit Replacement. Strap the channel unit and set the VF attenuators before testing.
4. Routine Maintenance. The recommended interval for routine maintenance is 2 years As part of the routine, a listening test should be made to verify absence of noise, crosstalk, etc
5. Common Equipment. If you replace a common equipment unit, testing may be postponed until the system can be removed from service conveniently
6. Crosstalk. This is an optional test used mainly for troubleshooting
7. The 91418 TREU may be installed instead of the 91438 Transmit and 91439 Receive Units

Test Record

3.06 An important part of testing is keeping an accurate record of results. Records of prior performance can be very helpful in troubleshooting. Also, the historical test data can be used to evaluate long-term system performance. The form shown in Figure 11 is suggested as a means of recording data from the initial tests and the subsequent periodic routine tests.

Figure 11. Sample Test Record Form.

Test	Notes	Requirements			Channel No. and Reading at Initial Test	Routine Test Period _____ Months					
						Date By	Date By	Date By	Date By	Date By	Date By
VF Level	1										
Idle Noise	2	23 dBrnc0 Maximum									
Idle Noise	3	TRANSMIT ATTENUATOR on 91232 Test Set	0 dB	57 or 47 dBrnc Max							
			-20 dB	37 or 27 dBrnc Max							
			-34 dB	29 or 19 dBrnc Max							
		SEND LEVEL on 91422 Test Set	0 dB	57 dBrnc Max							
			-10 dB	47 dBrnc Max							
			-20 dB	37 dBrnc Max							
			-30 dB	27 dBrnc Max							
			-40 dB	23 dBrnc Max							
Dial Pulse Signaling Distortion	4	Refer to applicable channel unit Practice listed in Table 2.									

NOTES:

1. VF Level. Initial applicable block to indicate that VF level has been checked on all channels
2. Idle Noise Test all channels; record data for two. If the measurements are made using the 91232 test set, the meter readings are in dBrnc. To convert to dBrnc0, algebraically subtract the transmission level at the point of test. For example, 23 dBrnc0 is 30 dBrnc at a +7 TLP or 20 dBrnc at a −3 TLP. If the measurement is made using the 91442 test set, the meter readings are in dBrnc0.
3. Distortion. Test all channels; record data for one. If the measurements are made using the 91232 test set, the lower distortion level listed above is for the 80-dBrnc reference.
4. Dial Pulse Signaling Distortion. Test all channels; record data for two.

Factory Repair Service

3.07 Field repair of units is not recommended. Failed units should be replaced with a spare. Units should be tagged, with the defect or problem identified, and sent to Siemens Communication Systems, Inc., Carrier Products Group, 501 Morris NE, Albuquerque, NM 87123-2840, Attention: Factory Service.

Technical Support Service

3.08 For technical assistance or after-hours emergency support, contact Siemens Communication Systems, Inc. Technical Services at (800)

255-1315 or (602) 395-5000. Normal business hours are 7:30 AM to 4:00 PM Mountain Standard Time.

Warranty Information

3.09 All recently manufactured units covered by a warranty contain a warranty marking on the printed circuit side of the unit. The marking consists of the letter "S" and a four-digit date code. (For example, a warranty marking consisting of "S 0789 indicates that the warranty period starts in July 1989.)

Performance Tests

3.10 Part 4 of this Practice has four channel performance tests using the 91442 VF Test Set and four equivalent tests using the 91232 Test and Alignment Set. The first of the four tests is done with the channel bank looped and does not depend on having an operational transmission facility between terminals. The other three are end-to-end tests.

NOTE: For some channel units, the procedures in Part 4 may not be applicable or must be modified. Before you begin testing, refer to the appropriate channel unit Practice listed in Table 2.

3.11 Figure 10 lists the test procedures in Part 4 and a system alarm restoral test procedure in Part 5 and notes their applicability to channel bank installation, routine maintenance, and unit replacement. Testing is to be done in both directions of transmission.

3.12 For routine maintenance with the channel bank in service, the VF level, idle noise, distortion, and impulse noise are measured on each channel, in turn. The recommended interval for routine maintenance is 2 years.

3.13 Because of the many signaling circuit variations, the procedures for measuring dial pulse signaling distortion and data channel unit performance are in the appropriate channel unit Practices (Table 2).

Restoration Patching

3.14 In a system failure, service may be restored on a small number of high-priority circuits by patching them to lower-priority channels in an adjacent working system. Connect a 796A Patch Cord between the TEST receptacle connector on the channel units at each end of the system. The channel units must be the same type and you may have to change strapping to coordinate levels and options. As shown in Figure 12a, the wiring in the 796A cord is "frogged" so that the carrier side of each channel unit is connected to the drop side of the other channel unit. Use the appropriate cable for the applicable channel unit

Table 4. List of Recommended Test Equipment.

QTY PER SITE	TEST EQUIPMENT	NOTES	DESCRIPTION AND USE
1	9140A Digital Test Set		Maintains one set of 9004A common equipment and two channel units in an operating condition on a looped basis; the condition of some units removed from a working bank can be verified by substituting the unit in the test set; four rack mounting spaces. Additional plug-ins are 91446 Signaling/Interface Unit and 91447 Selector Unit. (Practice 342-911-125)
1	91232 Test and Alignment Set	1	Provides a VF measuring circuit used in conjunction with external meters; supplies 1025-Hz test tone at 0 or -16 dBm; two rack mounting spaces. The digital section of the 91232 is for testing 9002A/B channel banks and is not applicable to 9004B. (Practice 342-911-103 or -107)
1	91442 VF Test Set	1	Portable or rack-mounting test set for measuring transmission level, noise, distortion, and crosstalk on an external meter such as a TTS-37B Noise Measuring Set; contains a 1020-Hz test-tone generator; connects to the channel unit TEST connector through a 796A Patch Cord; direction of test can be reversed without altering test setup; three rack mounting spaces. See Figure 18.
1	91443 Test Patch Panel	1, 2	Interface between the channel unit TEST connector and external test equipment, including the 91232 Test and Alignment Set; one rack mounting space. See Figure 27. -01 Two sets of channel unit access jacks, plus option code if applicable. -02 Four sets of channel unit access jacks; option codes are not applicable. Code DB Jack block equipped with 24 triple miniature TRS jacks; normal-through jacks and unwired monitor jack; wirewrap terminals. DC Same as Code DB except monitor jack is wired to normal-through jacks. DE Jack block for 24 triple miniature TRS jacks (not equipped).
1	91445 Signaling Path Test Set		Four-wire channel unit modified for VF and signaling tests on any channel; transmit/receive levels are a fixed -16/+7 dBm at the TEST connector; A and B signaling channels have switches for transmit control and LED's for receive indications.
1	26600 Signaling Test Set		Sends signaling pulses at selected rate and percent break; receives signaling pulses and measures percent break. (Practice 108-402-106)
1	Northeast Electronics TTS-37B with Noise Measuring Set	3	Noise and level measuring test set switch-type weighting networks and hold coil.

Table 4. List of Recommended Test Equipment (Continued).

QTY PER SITE	TEST EQUIPMENT	NOTES	DESCRIPTION AND USE
1	Northeast Electronics TTS-58A-CN Impulse Noise Counter		Counts number of pulses exceeding a selected level over a selected time interval.
1	Hewlett-Packard 204C Oscillator	3	For optional frequency response tests, 200 to 3400 Hz at 0 dBm.
1	Volt-Ohm-Milliammeter/Digital Voltmeter		General-purpose multimeter with 20,000-ohms/volt sensitivity.
2	725A Cord (135-42822-01)		Two-conductor cable 12 feet long wired between tip and sleeve of two 310-type tip-ring-sleeve telephone plugs; used to supply -48V power to 26600, TTS-37B, TTS-58A, 91442, and 9140A.
2	796A Patch Cord (035-56967-xx)		Twelve-conductor cable with a double-sided printed circuit plug connector on each end; connects TEST receptacle connector on channel unit to CHANNEL UNIT receptacle connector on 91442 VF Test Set or 91443 Test Patch Panel; also usable for restoration patching between certain channel units. 796A-01 6 feet long; 035-56967-01 796A-02 12 feet long; 035-56967-02
2	796B Test Cord (035-56501-01)	2	Two two-conductor cables 10 feet long with miniature tip-ring-sleeve telephone plugs on one end; the other ends terminate at a printed circuit plug connector; used to access T-R and T1-R1 leads toward the carrier at a channel unit TEST receptacle connector.
2	796C Test Cord (035-56501-02)	2	Two-conductor cable 10 feet long with a 310-type tip-ring-sleeve telephone plug on one end; the other end terminates at a printed circuit plug connector; used to access E&M leads toward the carrier at a channel unit TEST receptacle connector.
2	6000A-01 600-Ohm Terminating Plug (135-53521-01)		Miniature telephone plug with a 600-ohm resistor between tip and ring.
1	6000H-01 Adapter (135-54805-01)		Converts miniature tip-ring-sleeve telephone plug to 310-type plug; used with 796B Test Cord and 26600 Signaling Test Set for loop pulsing tests.
2	6100B-02 Cord (135-56150-02)		Shielded two-conductor cable 10 feet long with a miniature tip-ring-sleeve telephone plug on one end and a twin banana plug on the other end; equivalent to 6000B-02.
2	6100C-02 Cord (135-56151-02)		Shielded two-conductor cable 10 feet long with a miniature tip-ring-sleeve telephone plug on each end; equivalent to 6000C-02.

Table 4. List of Recommended Test Equipment (Continued).

QTY PER SITE	TEST EQUIPMENT	NOTES	DESCRIPTION AND USE
2	6100D-02 Cord (135-56152-02)		Shielded two-conductor cable 10 feet long with a 310-type tip-ring-sleeve telephone plug on one end and a miniature tip-ring-sleeve telephone plug on the other end; equivalent to 6000D-02.
24	022-56637-01 Open Plug		Fiberglass board 1.75 x 1.08 x 0.062 inches with a 5/8-inch diameter finger hole; inserted in channel unit TEST receptacle connector to disconnect T-R, T1-R1, and E&M leads toward the office.
2	141-54484-01 Open Plug		Dummy (plastic) miniature telephone plug.
1	91449 Channel Unit Extender		Extender plugs into shelf and channel unit plugs into extender; has normal-through miniature telephone jacks to access VF and signaling circuits and pin jacks to access supervisory and power leads.
1	TEKELEC Model TE820A Frame Simulator-Analyzer		DS1 transmission frame simulator.

NOTES:

1. Channel Performance Tests. Designed specifically for the 9004A/B PCM Channel Bank, the 91442 VF Test Set is recommended for channel performance tests. The combination of a 91232 Test and Alignment Set and a 91443 Test Patch Panel is an alternative.

2. 91232 Test and Alignment Set. In performance tests with the 91232 test set, the channel unit is accessed through a 796A Patch Cord, a 91443 Test Patch Panel, and a 6100C-02 Cord. A 796B Test Cord can be used as an alternative to these three items.

3. Transmission Test Set. Northeast Electronics TTS-44 Transmission Test Set may be used as an alternative to the TTS-37B for level and noise measurements. It may also be used as a signal generator for frequency response tests in lieu of the Hewlett-Packard 204C Oscillator.

4. Test Cords. Practice 032-201-150 provides a listing of test cords, plugs, and adapters.

5. Program Channel Units. Practice 342-911-126 lists additional test equipment used with program channel units.

6. Data Channel Units. Practice 342-911-160 lists additional test equipment used with digital data channel units.

Table 5. Channel Bank Controls and Indicators.

EQUIP.	NAME	DESCRIPTION	FUNCTION
91420 Alarm Control Unit	LOOP	Locking pushbutton and green LED	If the SYS ALM lamp and ACO indicator are lighted, depressing the LOOP pushbutton does the following: lights the LOOP indicator; loops the 48-channel (Mode 1) or 24-channel (Mode 2 or 3) digital signal from the transmit unit to the receive unit; transmits an all-1's signal to the digital line.
	ACO	Nonlocking pushbutton and green LED	If the SYS ALM lamp is lighted, depressing the ACO pushbutton operates the alarm cutoff relay and lights the ACO indicator. Relay operation disables the audible alarm and visual alarm (strapping option) circuits to the office but does not affect the EAX alarm circuit. The alarm cutoff relay releases automatically when the system alarm condition clears.
	LOC	Red LED	Indicates loss of receive signal or an out-of-frame condition. LOC has a 40-ms integration time, whereas FR SCH on the receive unit is instantaneous.
	REM	Yellow LED	Indicates the remote channel bank is in a system alarm condition, initiated by a local alarm or maintained by an operated TMB HOLD pushbutton.
	TMB HOLD	Locking pushbutton and green LED	With the SYS ALM lamp and ACO indicator lighted, depressing the TMB HOLD pushbutton forces bit 2 of the transmit channel words to 0 and maintains the system alarm condition. The TMB HOLD indicator lights while the pushbutton is depressed. If the digital line signal is looped back, REM lights if the signal is received and framed upon; otherwise LOC lights.
	SYS ALM	Yellow lamp	Indicates a system alarm condition, which is initiated by a power, local, or remote alarm. With the alarm cutoff relay operated, a system alarm is maintained by an operated LOOP or TMB HOLD pushbutton.
	SYS ALM	Three-digit electro-mechanical counter	Records number of system alarms.
Channel Unit	BUSY	Red LED	Lights in response to an off-hook condition in the transmit or receive direction.
	NORM/ BUSY	Slide switch	When the switch is set to BUSY position, the channel is made busy toward the drop and toward the far end according to channel unit type and strapping options.
91448 Office Interface Unit	ALARM U (digroup B) and ALARM L (digroup A)	Yellow LED	Lights 2.5 seconds after LOC or REM on alarm control unit lights. Cleared by RESET button but lights again if alarm still exists.
	RESET	Locking pushbutton	Clears yellow alarm indicators.

Table 5. Channel Bank Controls and Indicators (Continued).

EQUIP.	NAME	DESCRIPTION	FUNCTION
91436 Power Distribution Unit	FUSE ALM	Red LED	Indicates a blown fuse (but not AUX fuse).
	TALK FUSE ALM A and B	White-red LED	Indicates a blown TALK BAT fuse.
91425 Power Supply Unit	ALM	Red LED	Indicates failure of the +5, -5, +12, or -12-volt power supply outputs.
91438 Receive Unit	FR SCH	Red LED	Indicates loss of receive signal or an out-of-frame condition. The FR SCH indication is instantaneous, whereas the LOC indication on the alarm control unit has a 40-ms integration time.
	ON/OFF	Slide switch	If the alarm control unit is in loop condition, setting the switch to ON position injects a digital test tone (1-kHz, 0-dBm0) in each channel of both digroups (Mode 1) or the applicable digroup (Mode 2 or 3).
	TONE	Green LED	Indicates injection of digital test tone.
91426 Syndes Unit	TEST	Nonlocking pushbutton	If one or both alarm control units is in the loop condition, momentarily depressing the TEST pushbutton loops the DS1C signal and unloops the digroup(s) for 300 ms.
	PASS	Green LED	When the TEST pushbutton is depressed, the PASS indicator lights if the syndes unit and the receive units reframe to the looped DS1C signal; the indicator remains lighted until the TEST pushbutton is released.
	FAIL	Red LED	When the TEST pushbutton is depressed, the FAIL indicator lights if the syndes unit or receive unit (either or both digroups) does not reframe to the looped DS1C signal; the indicator remains lighted until the TEST pushbutton is released.
	LOCAL	Red LED	Lights when the syndes unit is out of frame for longer than 200 ms.
	REMOTE	Yellow LED	Lights when the remote alarm bit in the receive DS1C signal indicates an alarm condition at the distant terminal (M4 = 0).
91418 Transmit and Receive Extended Super-frame Unit	TONE ON/OFF	Slide switch	If the alarm control unit is in loop condition, setting the switch to ON position injects a digital test tone (1-kHz, 0-dBm0) in each channel of the applicable digroup.
	TONE	Green LED	When lit, indicates injection of digital test tone.
	LOS	Red LED	Loss of Signal. When lit, indicates that no pulses have been detected in the incoming signal.
	AIS	Red LED	Alarm Indication Signal. When lit, indicates that the alarm signal has been received.

Table 5. Channel Bank Controls and Indicators (Continued).

EQUIP.	NAME	DESCRIPTION	FUNCTION
91418 Transmit and Receive Extended Super-frame Unit (Continued)	OOF	Red LED	Out of Frame. When lit, indicates a framing problem.
	EXT CLK	Strapping Plug	Used to select the external clock. Refer to Figure 8.
	LP CLK	Strapping Plug	Used to select the loop (internal) clock. Refer to Figure 8.
	B8ZS	Strapping Plug	Used to select the B8ZS format. Refer to Figure 8.
	RPIU INTERFACE	20-Pin Connector	Connects the interface cable to the 91419 RPIU.
91419	RPIU ALARM	Red LED	Lights during the initialization process. Stays lit if a problem is encountered during initialization. Messages may also be sent to the terminal connected to the RS-232-C port explaining the initialization failures.
	DP-B	Yellow LED	Degraded Performance Indicator for Digroup B. When lit, indicates that a performance monitor threshold has been exceeded. The event history table available at the terminal connected to the RS-232-C port should contain a message indicating exactly which threshold was exceeded.
	DP-A	Yellow LED	NOTE: The EXCEPTIONS command provides a quick way of finding which threshold was exceeded. Degraded Performance Indicator for Digroup A. When lit, indicates that a performance monitor threshold has been exceeded. The event history table available at the terminal connected to the RS-232-C port should contain a message indicating exactly which threshold was exceeded.
	RPIU RESET	Pushbutton	Manual (Recessed) Reset Pushbutton. Used to reset the hardware and software configurations.
	RPIU TREU-B	20-Pin Connector	Connects the interface cable to the 91418 TREU for digroup B.
	RPIU TREU-A	20-Pin Connector	Connects the Interface cable to the 91418 TREU for digroup A.

4. CHANNEL PERFORMANCE TESTS

Channel Unit Test Access

4.01 The 91442 VF Test Set is recommended for channel performance testing. However, the 91232 Test and Alignment Set used in 9002A/B channel bank maintenance is a suitable alternative. A 91443 Test Patch Panel (or 796B Test Cords) is required with the 91232 test set. With either test set, an external level/noise meter and VF signal generator (for frequency response) are required.

4.02 Figure 12a shows the 91442 test set or 91443 panel connected to a channel unit through a 796A Patch Cord. Channel transmit, receive, and E&M circuits are then accessible on the 91442 or 91443 in either direction, toward the drop or toward the carrier.

NOTE: The 796A Patch Cord has a transposition in each of the six pairs of wires. This enables the 796A to be used for restoration patching between the TEST connectors on certain channel units.

4.03 Figures 12b and 12c show how the channel transmit and receive circuits or the E&M circuits are accessible toward the carrier through a 796B or 796C Test Cord. The 796B cord has miniature tip-ring-sleeve plugs that mate with jacks on a 91232 test set. The 796C cord has a 310-type plug that mates with E&M jacks on a 26600 Signaling Test Set.

4.04 **Channel Units with Telephone-Type Jacks.** Some channel units provide test access through miniature telephone-type jacks instead of a 12-pin TEST connector. Figures 13a and 13b show the locations of jacks in the VF transmit and receive signal paths. Figures 13c through 13f show how to connect the channel units to a 91442 or 91232 test set. These connections, made with 6100C-02 Cords, eliminate the 796A Cords and the 91443 Test Patch Panel, which are called out in the channel performance tests, Figures 19 through 26. Channel units with telephone-type jacks are as follows:

- 91403-11, DPO
- 91405-11, DPT
- 91407-12, 4W TANDEM
- 91434-12, 4W SF FX
- 91450-11, SD/WO
- 91451-11, 4W TO
- 91451-22, 4W ETO
- 91452-11, 2W E&M 900 OHM
- 91452-12, 2W E&M 600 OHM
- 91454-11, 4W E&M
- 91458-11, FXO
- 91458-12, FXO
- 91459-11, FXS
- 91459-12, FXS
- 91474-11, 4W DUPLEX
- 91478-11, 4W FXO
- 91479-11, 4W FXS

4.05 In Figure 13c, test tone levels are coordinated by setting the XMT ATTEN and RCV ATTEN on the 91442 test set and the channel unit to the same values. In Figure 13d, setting the XMT ATTEN to 1.5 dB gives a – 16 dBm transmit test tone. Also, with the RCV ATTEN set at 1.5 dB, + 7 dBm at the 4W RCV CARR jack produces a 0-dBm meter reading.

4.06 In Figure 13e, the test tone level is 0 dBm, nonadjustable. If the channel unit attenuators are set to 4.5 dB transmit and 3.0 dB receive, the transmit/receive levels at the 2W CARR jack will be 0/ – 3 dBm. In Figure 13f, the transmit test tone is – 16 dBm, as required at the 4W XMT CARR jack.

4.07 In Figures 13e and 13f, measurements made through the 91232 test set indicate the actual level at the 2W CARR jack or the 4W RCV CARR jack.

VF Levels

4.08 The VF transmit and receive signal paths of two-wire and four-wire channel units are illustrated in Figure 14. The 6.3-dB transmit/receive precision attenuators are shown strapped for 4.5/3.0 dB two-wire or 1.5/1.5 dB four-wire, and the four-wire tandem attenuators are strapped for 0 dB. This factory strapping results in standard transmit/receive levels at the TEST receptacle connector of 0/-3 dBm two-wire and -16/ + 7 dBm four-wire.

Test Descriptions

4.09 Procedures in Part 4 include measurement of VF level, idle noise, distortion, impulse noise, frequency response, and crosstalk. Channel units are tested in pairs on an end-to-end or loopback basis; each direction is tested, in turn.

NOTE: When the 91418 TREU is installed, all test procedure references to the 91438 Transmit Unit and 91439 Receive Unit will apply to the 91418 TREU.

4.10 **VF Level.** VF drop level is measured at the receive channel unit with a 1-kHz analog test tone applied to the transmit channel unit. In loopback testing, the level of a digital test tone is measured also. The digital test tone is a coded PCM signal, 1 kHz at 0 dBm0, generated and inserted within the receive unit of the local channel bank. Levels are coordinated with the VF drop equipment by strapping the channel unit transmit and receive precision attenuators; there are no variable controls for field level adjustment.

NOTE: The frequencies of the analog test tone supplied by the 91232 and 91442 test sets are 1025 Hz and 1020 Hz, respectively. The digital test- tone frequency is 1000 Hz.

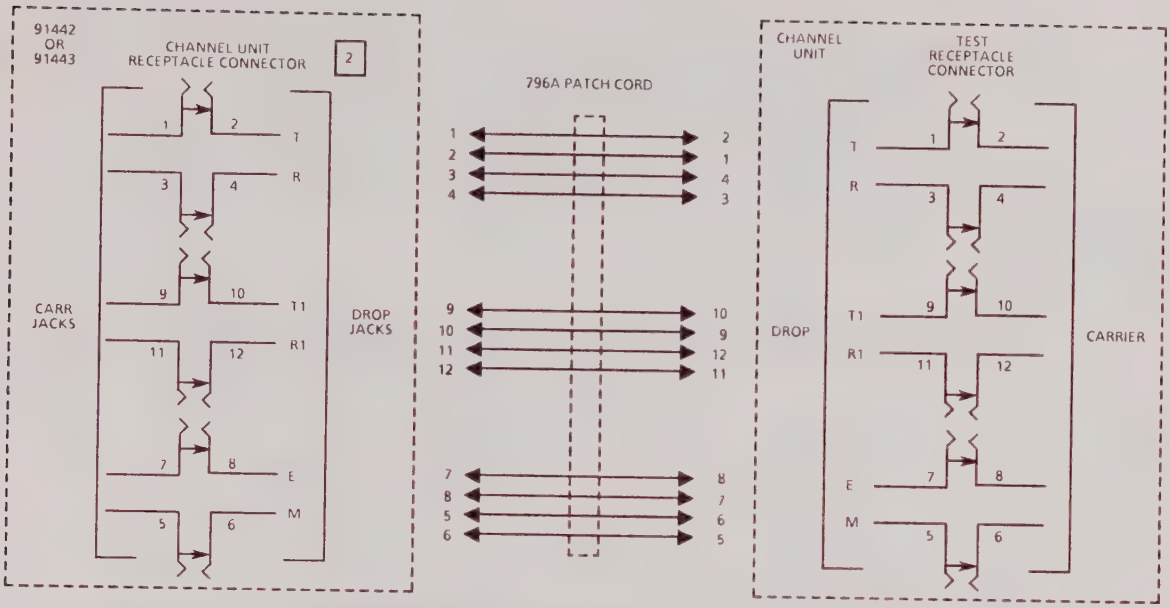


Figure 12a. Access Through 796A Patch Cord and 91442 VF Test Set or 91443 Test Patch Panel. 1

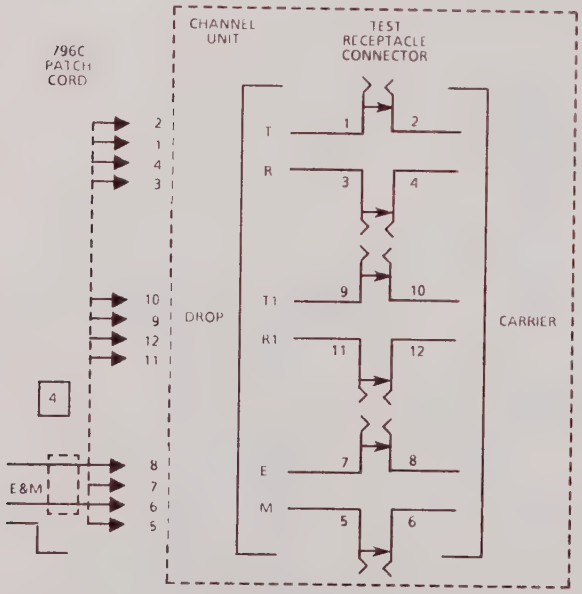


Figure 12c. Access Through 796C Patch Cord.

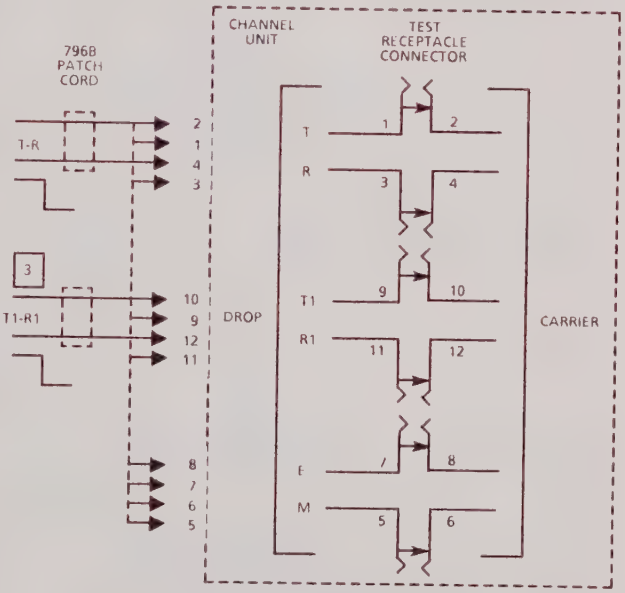


Figure 12b. Access Through 796B Patch Cord.

NOTES:
1. TEST on the channel unit is patched to CHANNEL UNIT on the 91442 or 91443 with a 796A cord. The normal-through contacts on the receptacle connectors open when the cord is inserted.
2. Contacts of the CHANNEL UNIT receptacle connector are normal through on the 91442, but not on the 91443.
3. T-R and T1-R1 plugs on the 796B patch cord are miniature tip-ring-sleeve type.
4. E-M plug on the 796C cord is a tip-ring-sleeve type 310.

Figure 12. Access to Channel Unit VF and Signaling Circuits for Testing.

Figure 13a. 2-Wire Channel Unit Without 4W Jacks (Note 1).

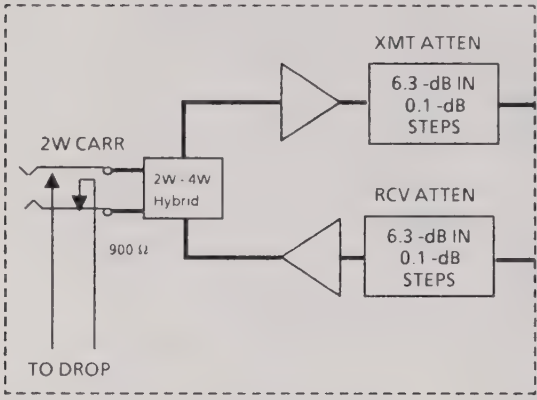


Figure 13b. 2-Wire or 4-Wire Channel Unit with 4W Jacks (Note 2)

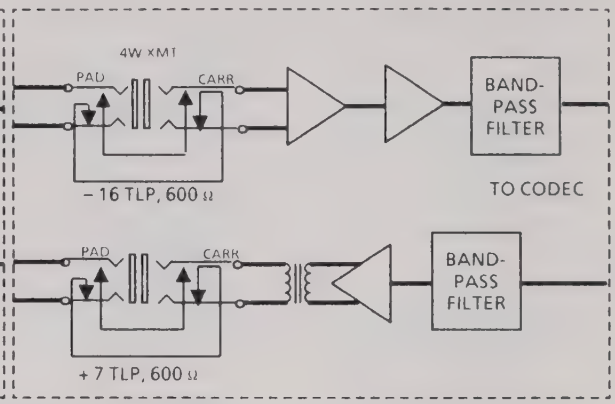


Figure 13c 91442 VF Test Set to 2W CARR Jack

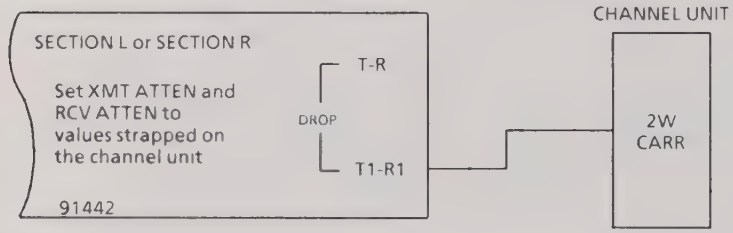


Figure 13d. 91442 VF Test Set to 4W CARR Jacks.

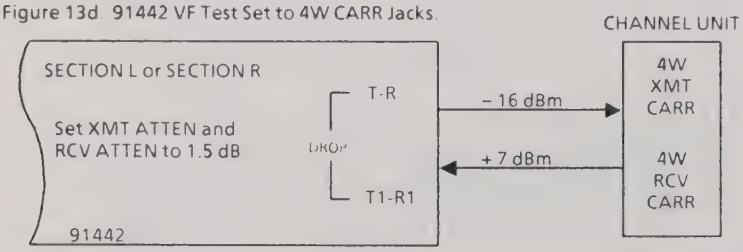


Figure 13e. 91232 Test Set to 2W CARR Jack.

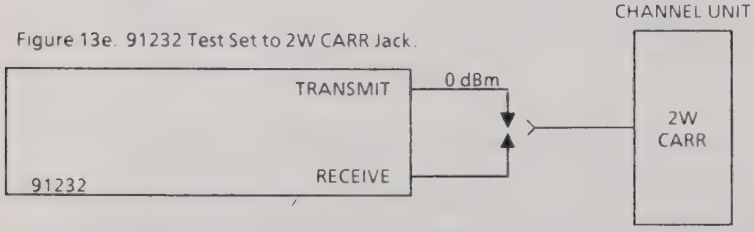
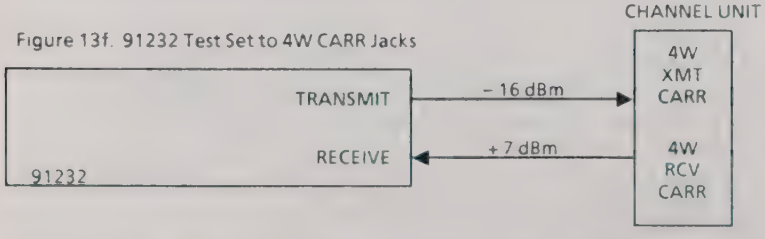


Figure 13f. 91232 Test Set to 4W CARR Jacks



NOTES:

1 FIGURE A APPLIES TO THE FOLLOWING CHANNEL UNITS:
- 91403-11 DPO
- 91405-11 DPT
- 91450-11 SD/WO

2 FIGURE B APPLIES TO THE FOLLOWING CHANNEL UNITS:
- 91407-12 4W TDM
- 91434-12 4W SF FX
- 91451-11 4W
- 91451-22 4W ETO
- 91452-11 AND -12 2W E&M
- 91454-11 4W E&M
- 91458-11 FXO
- 91458-12 FXO
- 91459-11 FXS
- 91459-12 FXS
- 91474-11 4W DUPLEX
- 91478-11 4W FXO
- 91479-11 4W FXS

3 ALL TEST CORDS ARE TYPE 6100C-02 WITH A MINIATURE TIP-RING-SLEEVE TELEPHONE PLUG ON EACH END

Figure 13. Test Setups for Channel Units with Telephone-Type Jacks.

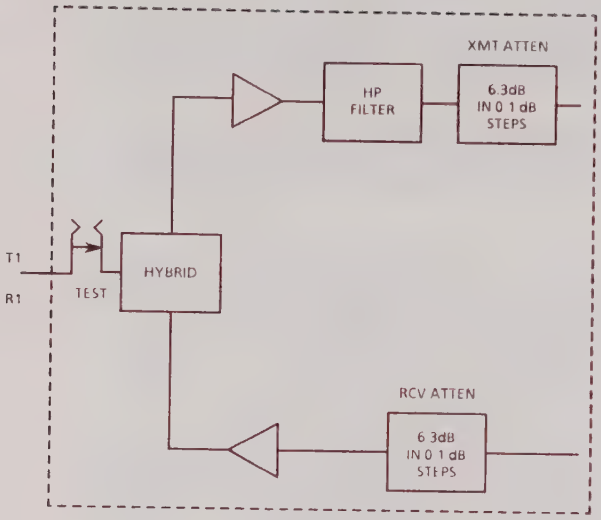


Figure 14a. Two-Wire Channel Unit.

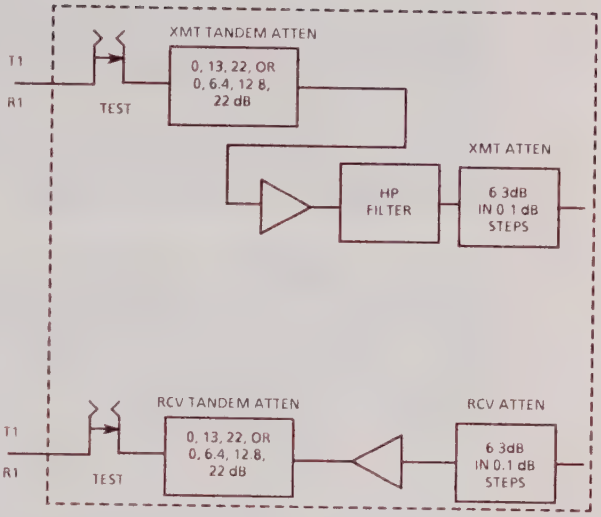


Figure 14b. Four-Wire Channel Unit.

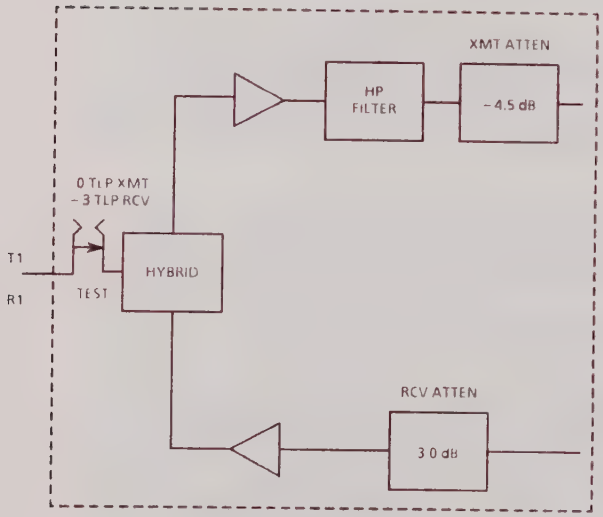


Figure 14c. Two-Wire Channel Unit Strapped for 0/ – 3 TLP.

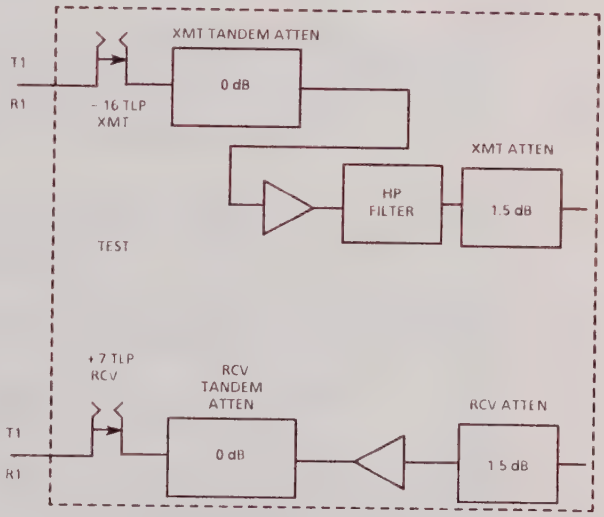


Figure 14d. Four-Wire Channel Unit Strapped for – 16/ + 7 TLP.

Figure 14. Channel Unit VF Levels.

4.11 The tolerance on channel unit VF levels is much tighter than the accuracy of many commonly-used level meters (typically, ±0.5 dB). Therefore, the accuracy of the particular meter used must be considered in evaluating the channel performance test results.

4.12 **Idle Noise.** Idle noise is measured at the receive channel unit output with the transmit channel unit input terminated. The specification is 23 dBrnc0 maximum.

4.13 **Distortion.** A 1-kHz analog test tone is applied to the transmit channel unit input and the level is measured at the receive channel unit output. The level measuring circuit includes a 1-kHz band elimination filter so that the meter indicates harmonic distortion of 1 kHz plus quantizing distortion products.

4.14 Distortion is measured at several transmit levels to check codec linearity. The number of transmit levels is three from the 91232 test set and five from the 91442 test set. In the end-to-end channel performance test, if the test set is 91232 at one channel bank and 91442 at the other, the meter readings at the receive channel bank should be as specified in the procedure applicable to the test set at the transmit channel bank.

4.15 **Impulse Noise.** The transmit channel unit input is terminated (a holding tone is not required) and the receive channel unit output is connected to an impulse noise counter. Impulses that exceed a threshold level are tallied over a 5-minute period. Impulse noise is usually measured on an end-to-end basis only.

4.16 If the test is performed on an in-service system, normal supervision and random dialing may be present on the other channels, but continuous dial pulsing is not allowed. The repeatered line should be essentially error-free to avoid having any contribution to the reading made by impulse noise generated in the line.

4.17 **Channel Frequency Response.** Usually, channel frequency response is measured on an end-to-end basis only. The specification for a four-wire channel is 0 to -3 dB at 200 Hz and 3400 Hz relative to 1000 Hz. If the channel unit at either or both ends is a two-wire type, the specification at 200 Hz is 0 to -5 dB.

4.18 **Channel Crosstalk.** As an optional end-to-end test, mainly for troubleshooting, crosstalk into the channel under test is measured from the channel that precedes and the channel that follows in the sampling sequence. The specification is 25 dBrnc0 maximum.

NOTE: In the 9002A and 9002B channel banks, crosstalk usually originates in the transmit encoder, which is common to all channels. However, this crosstalk source is not applicable to the 9004B channel bank, which has individual channel codecs.

Conditioning Channels for Test

4.19 **End-to-End Testing.** When a channel is idle, as shown by dark BUSY indicators, the channel is appropriated for end-to-end testing by setting the NORM/BUSY switch to BUSY on the channel unit at each end. This busies the local switching equipment to prevent intrusion and lights the BUSY indicator. For certain applications, the effect of the NORM/BUSY switch is modified by channel unit strapping options; refer to Figure 15.

NOTE: The NORM/BUSY switch on the 91405 DPT Channel Unit must be in NORM position for end-to-end testing

4.20 For end-to-end pulsing tests, the NORM/BUSY switch is set in BUSY position to appropriate the channel. After a test setup with the signaling test set has been arranged, the switch is returned to NORM position to enable pulsing.

4.21 **Loop Testing.** Looping the channel bank via the 91420 ACU produces the following changes from normal end-to-end operation to allow testing from the VF input of one channel to the VF output of another channel via the common equipment and digital loopback.

(a) Channels are linked in pairs with an offset that depends on the selected channel sampling sequence: D3, D2, or D1D.

(b) VF transmission is enabled and signaling is disabled.

(c) The TMB function of the channel bank is activated; this busies the local switching equipment and lights the channel unit BUSY indicators; refer to Figure 16.

4.22 **91405 DPT Channel Unit.** As shown in Figure 17a, ground through pins 7-8 of the TEST receptacle connector produces logic 1 at the signaling circuit "Test" input to enable normal P relay operation. Some special considerations related to this feature are as follows.

4.23 In end-to-end VF testing, seizure of the channel unit at the originating end operates the P relay, which closes the two-wire VF path and removes the transmit mute. In loop testing, seizure is not possible because signaling is disabled when the channel bank is looped back. However, with the NORM/BUSY switch in NORM, the P relay is forced to operate by lifting the ground at pin 8 of the TEST connector. This occurs when a 796A Patch Cord is inserted as shown in Figures 17b and 17c. But, note that the circuit through the 91443 panel in figure 17c is closed, and an open plug must be inserted in the E&M CARR or DROP jack. (Ground at pin 8 is also lifted if a 796B Test Cord is used to access the channel unit two-wire VF circuit.)

Figure 15. Effect of Channel Unit NORM/BUSY Switch on End-To-End Testing.

CHANNEL UNITS	STRAPPING PLUG POSITIONS	NORM/BUSY SWITCH IN BUSY
91402 2W E&M 91404 4E E&M	R	Inhibits E relay (Model 1); does not affect E relay (Model 2).
	R and K	Grounds C1 lead, if Code A is equipped.
	S	Operates E relay, forcing a local busy.
	O (Model 2)	Sends off-hook via M lead to force a remote busy.
	P (Model 2)	Does not affect M lead
91403 DPO	All options	Removes VF transmit mute.
	B, D, and J	Operates B relay, grounding C lead. See Note 1.
	A, C, and F	Operates B relay, closing B1-B2 leads.
91405 DPT	None	Sends reverse battery indication to originating end; disables P relay. See Note 2.

NOTES:

1. DPO Channel Unit. If strapping is B, D, and J, a reverse battery indication sent from the DPT channel unit releases the F relay in the DPO channel unit, grounding the C lead. If reverse battery is the normal (idle) condition at the DPT channel unit, this feature is disabled at the DPO channel unit by strapping A, D, and I instead of B, D, and J.

2. DPT Channel Unit. In end-to-end testing, the NORM/BUSY switch on the DPT channel unit must be in NORM position. Then, a loop closure at the DPO channel unit will operate the P relay on the DPT channel unit.

Figure 16. Effect on TMB on Loop Testing.

CHANNEL UNITS	STRAPPING PLUG POSITIONS	EFFECT OF ACTIVATED TMB
91402 2W E&M 91404 4E E&M	O and N	E-lead on-hook.
	P and N	E-lead on-hook for 2 seconds and then off-hook.
	P and M	E-lead off-hook.
91403 DPO	P	B relay operates, grounding C lead. After 2 seconds, C lead is winked open for 50 milliseconds. Normal battery is applied to tip and ring.
	O	
91405 DPT	No options	P relay is disabled, opening VF path to two-wire drop. See Note 1.

NOTES:

1. DPT Channel Unit. In the looped channel performance tests with the 91443 Test Patch Panel, an open plug must be inserted in the E&M CARR jack of the 91443 to force operation of the P relay and remove VF transmit mute.

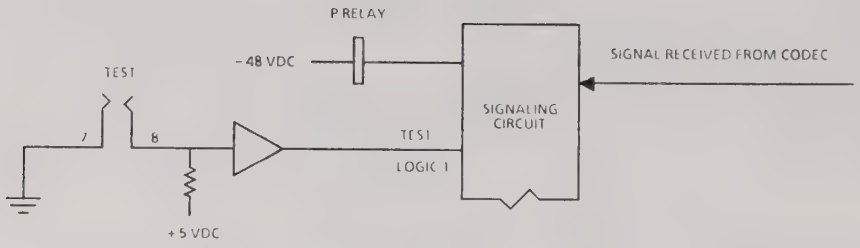


Figure 17a. 91405 DPT Channel Unit.

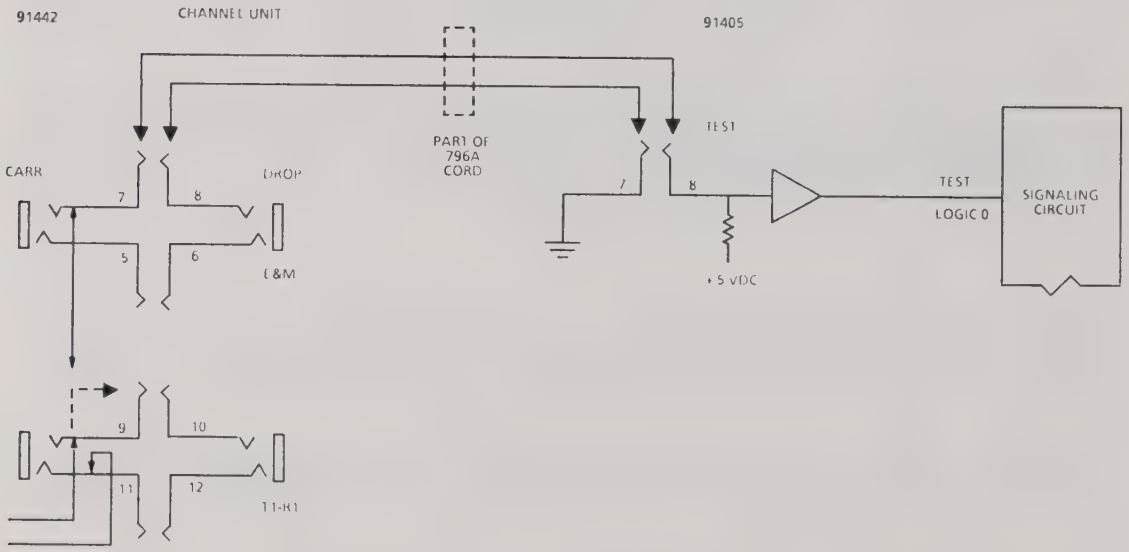


Figure 17b. Part of Test Setup with 91442 VF Test Set.

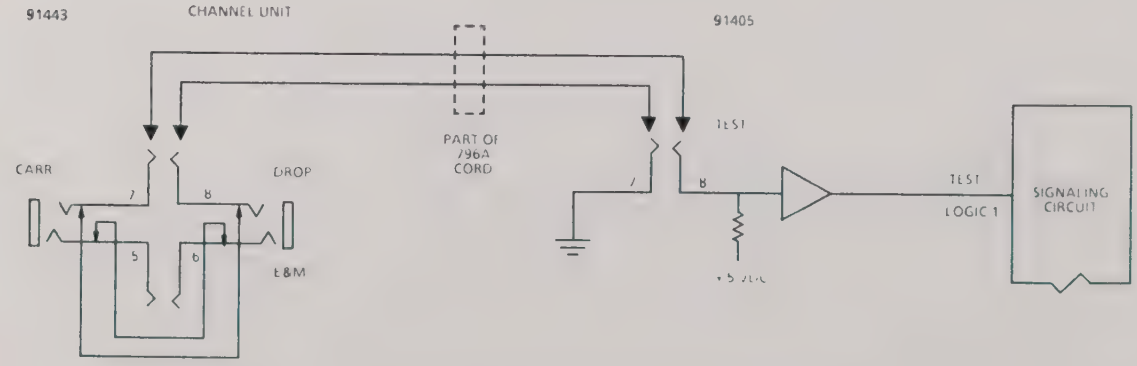


Figure 17c. Part of Test Setup with 91443 Test Patch Panel.

Figure 17. 91405 DPT Channel Unit, P Relay Control.

4.24 In end-to-end pulsing tests that utilize the 91442 test set for access to the channel unit, the cord inserted in the T1-R1 CARR jack grounds pin 8 of the channel unit TEST connector (Figure 17b) to enable P relay operation.

4.25 Pins 7-8 of the TEST connector on an E&M channel unit are assigned to the E lead. As shown in Figure 17b, the cord inserted in the T1-R1 CARR jack for VF tests grounds the E lead, but the ground is lifted when a cord is inserted in the E&M CARR jack for pulsing tests.

91442 VF Test Set

4.26 The 91442 VF Test Set (Figure 18) has two independent sections, L on the left and R on the right, and a common center section. In end-to-end tests, the TEST receptacle connector on the channel unit is patched to the CHANNEL UNIT receptacle connector in Section L or Section R, as specified in the procedure. In loop tests, one channel unit is patched to Section L and the other to Section R. Patching is done with 12-conductor 796A Patch Cords.

CAUTION

THE TEST AND CHANNEL UNIT RECEPTACLE CONNECTORS SHOULD BE ACCESSED ONLY WITH 796-TYPE CORDS. DO NOT USE PIN PRODS OR PROBES TO MAKE MEASUREMENTS AT INDIVIDUAL CONTACTS. PERMANENT DAMAGE TO THE CONTACT MAY RESULT.

4.27 The single XMT-RCV toggle switch in the center section has two positions: L-R and R-L. In position L-R, an analog test tone from the internal oscillator or an external oscillator is routed to the transmit input of a channel unit patched to Section L, and the receive output of a channel unit patched to Section R is routed to the LEVEL, DISTN, and CRSTLK jacks. An external meter is connected to the applicable jack as specified in the procedure. The internal circuit at the DISTN jack includes a 1020-Hz band elimination filter and the circuit at the CRSTLK jack includes a 1020-Hz bandpass filter.

4.28 Setting the XMT-RCV switch to position R-L reverses the direction of transmission described above. That is, the test tone goes to the transmit input of the channel unit patched to Section R, and the receive output of the channel unit patched to Section L goes to the external meter.

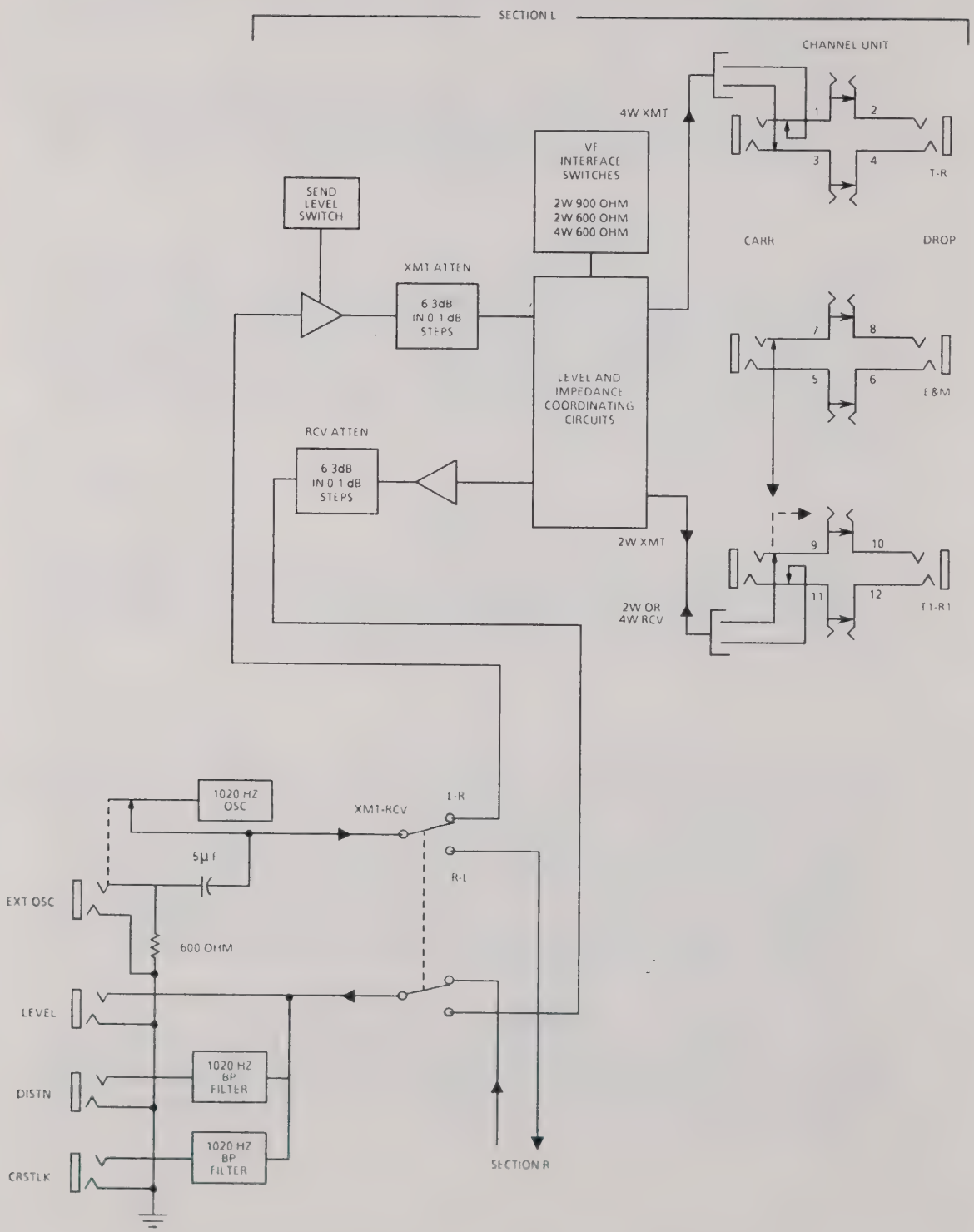


Figure 18. 91442 VF Test Set.

4.29 Sections L and R each have three mechanically interlocked VF INTFC pushbutton switches: 2W 600, 2W 900, and 4W 600. Levels and impedances are coordinated between the test set and channel unit by depressing the applicable pushbutton.

NOTE: Channel units are color-coded according to functional type; for example, a white bar on the label means 4W E&M. The color of the test set pushbuttons is not related to the channel unit color code.

4.30 With a channel unit patched to the test set through a 796A cord, the VF and signaling circuits of the channel can be accessed toward the drop and toward the carrier through the test set T-R, T1-R1, and E&M jacks. These jacks are used, for example, in performing pulsing tests with a 26600 Signaling Test Set.

4.31 **VF Levels.** The transmit and receive attenuators on the test set are switch-selectable in 0.1-dB steps between 0 and 6.3 dB. With these attenuators set at the same values as the strappable attenuators on the channel unit under test, the normal receive level indication on an external meter is 0 dBm. This applies to a two-wire channel unit or to a four-wire channel unit with tandem attenuators strapped for 0 dB loss.

4.32 **Performance Tests.** Test procedures using the 91442 VF Test Set are in Figures 19 (loop), 20 (end-to-end), 21 (frequency response), and 22 (crosstalk).

91232 Test and Alignment Set

4.33 The 91232 Test and Alignment Set is illustrated and described in Practice 342-911-103 (9002A channel bank) and Practice 342-911-107 (9002B channel bank). The digital section of the 91232 is not applicable to testing the 9004B channel bank.

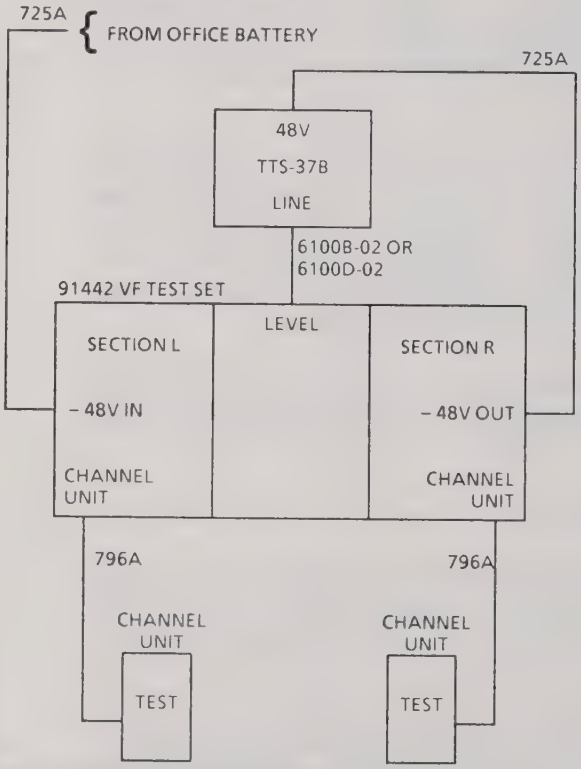
4.34 The 91232 test set has a measuring circuit used in conjunction with an external meter, such as the TTS-37B Noise Measuring Set; it also supplies a 1025-Hz test tone at 0 dBm or -16 dBm. The measuring circuit is passive, but the test-tone oscillator operates from -48 volts. When required, a connection to office battery is made at the 48V/OUT jack with a 725A Cord. (The jack is a 48-volt output in 9002A/B applications.)

4.35 **VF Levels.** In Figure 14, the transmit/receive attenuators on the channel unit are shown strapped for 4.5/3.0 dB two-wire or 1.5/1.5 dB four-wire. The resulting levels at the TEST connector are 0/-3 dBm two-wire or -16/+7 dBm four-wire. If the attenuators are strapped otherwise, the receive level measured using the 91232 test set will be affected accordingly.

Figure 19. Looped Channel Performance Test with 91442 VF Test Set (Sheet 1 of 2).

Description of Test. The digital transmit signal of the channel bank is looped to the receive branch, linking the channels in pairs. See table on sheet 2. In Mode 1, the loop affects both digroups; in Modes 2 and 3, the digroups can be looped independently.

Each pair of channel units is tested in both directions for VF level, idle noise, and distortion. VF level is measured at the output of the receive channel unit, first with a digital test tone and then with an analog test tone.



Step	Procedure
1	DIGITAL LOOPBACK
1a	If the SYS ALM lamp on the alarm control unit is dark, create a system alarm, and then complete the next two steps within 10 seconds.
NOTE:	In Mode 1 or 3, the recommended way to initiate a system alarm is to open or short-circuit the digital receive line signal for a few seconds. If this is not convenient, or if the channel bank is Mode 2, momentarily unplug the alarm control unit, A or B as applicable.
1b	Depress and release ACO pushbutton. ACO indicator should light.
1c	Depress LOOP pushbutton. Green LOOP indicator should light.
2	TEST SET CALIBRATION CHECK
2a	Set up test circuit shown in diagram, but do not connect 796A cords to 91442.
2b	Set controls on TTS-37B as follows: INPUT to 600Ω TERM HOLD to OFF FILTER to 3 KC
2c	In Sections L and R of the 91442, set controls as follows: XMT ATTEN to 4.5 dB RCV ATTEN to 0 dB VF INTFC to 2W 600Ω SEND LEVEL to 9 dB
2d	With a 6100C-02 Cord, connect together the T1-R1 DROP jacks in Sections L and R.
2e	In turn, set XMT-RCV switch on 91442 to position L-R and R-L. In each switch position, meter should read 0 ± 0.1 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11).
2f	Disconnect cord between T1-R1 DROP jacks.
3	TEST SETUP
3a	Select the channel unit pair for testing; for example, 1A and 13A (digroup A, D3 sequence)
3b	In Sections L and R of the 91442, set controls as follows: VF INTFC to channel unit impedance, 2W or 4W XMT ATTEN and RCV ATTEN to dB values strapped on channel unit (paragraph 4.31)
3c	Connect 91442 to channel units with 796A cords as shown in diagram.
4	VF LEVEL
4a	Set FILTER switch on TTS-37B to 3 KC.
4b	Set slide switch on receive unit to ON (up) position. Green TONE indicator(s) should light.
4c	In turn, set XMT-RCV switch to L-R and R-L. In each position, meter should read 0 ± 0.2 dBm (digital test tone). (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
4d	Restore slide switch on receive unit to OFF (down) position. Green TONE indicators should go dark.
4e	In turn, set XMT-RCV switch to L-R and R-L. In each position, meter should read 0 ± 0.3 dBm (analog test tone). (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)

Figure 19. Looped Channel Performance Test with 91442 VF Test Set (Sheet 2 of 2).

Step	Procedure
5	IDLE NOISE
5a	Set FILTER switch on TTS-37B to C MSG.
5b	Insert the terminating plug (6000A-01) in EXT OSC jack on 91442. (This disconnects the internal test tone source.)
5c	In turn, set XMT-RCV switch to L-R and R-L. In each position, meter reading should not exceed 23 dBrnc.
5d	Remove terminating plug from EXT OSC jack.
6	DISTORTION
6a	Set FILTER switch on TTS-37B to C MSG.
6b	Connect TTS-37B to DISTN jack (instead of LEVEL jack) on 91442.
6c	Set XMT-RCV switch to L-R.
6d	In turn, set SEND LEVEL switch in Section L to each of its five positions. Meter readings should not exceed the following:

SEND LEVEL	Meter
0 dB	57 dBrnc
– 10 dB	47 dBrnc
– 20 dB	37 dBrnc
– 30 dB	27 dBrnc
– 40 dB	23 dBrnc

6e	Restore SEND LEVEL switch to 0 dB.
6f	Set XMT-RCV switch to R-L.
6g	Same as step 6d except in Section R.
6h	Restore SEND LEVEL switch to 0 dB.
6i	If other channels are to be tested, reconnect TTS-37B to LEVEL jack on 91442.
7	COMPLETION OF TEST
7a	Disconnect 796A cord from channel unit.
7b	Check that NORM/BUSY switch on channel units is set to NORM.
8	CHANNEL BANK MODE 1
8a	To test the next channel unit pair, return to step 3.
8b	Test channel unit pairs in succession through both digroups.
8c	When all channels have been tested in both directions, release the LOOP pushbutton.
9	CHANNEL BANK MODE 2 OR 3
9a	To test the next channel unit pair, return to step 3.
9b	Test channel unit pairs in succession through one digroup.
9c	When all channels have been tested in both directions, release the LOOP pushbutton.
9d	To test the other digroup, do step 1 and then return to step 3.

Looped Channel Pairs

D3 Sequence	D2 Sequence	D1D Sequence
1 and 13	1 and 2	1 and 7
2 and 14	3 and 4	2 and 8
3 and 15	5 and 6	3 and 9
4 and 16	7 and 8	4 and 10
5 and 17	9 and 10	5 and 11
6 and 18	11 and 12	6 and 12
7 and 19	13 and 14	13 and 19
8 and 20	15 and 16	14 and 20
9 and 21	17 and 18	15 and 21
10 and 22	19 and 20	16 and 22
11 and 23	21 and 22	17 and 23
12 and 24	23 and 24	18 and 24

Figure 20. End-to-End Channel Performance Test with 91442 VF Test Set (Sheet 1 of 3).

Description of Test. The channel is tested in both directions of transmission for VF level (analog test tone), idle noise, distortion, and impulse noise.

Channel banks are designated "L" and "R" arbitrarily. As shown in the diagram, the channel units are connected to Section L (left) and R (right) of the 91442 VF Test Set at bank L and bank R, respectively.

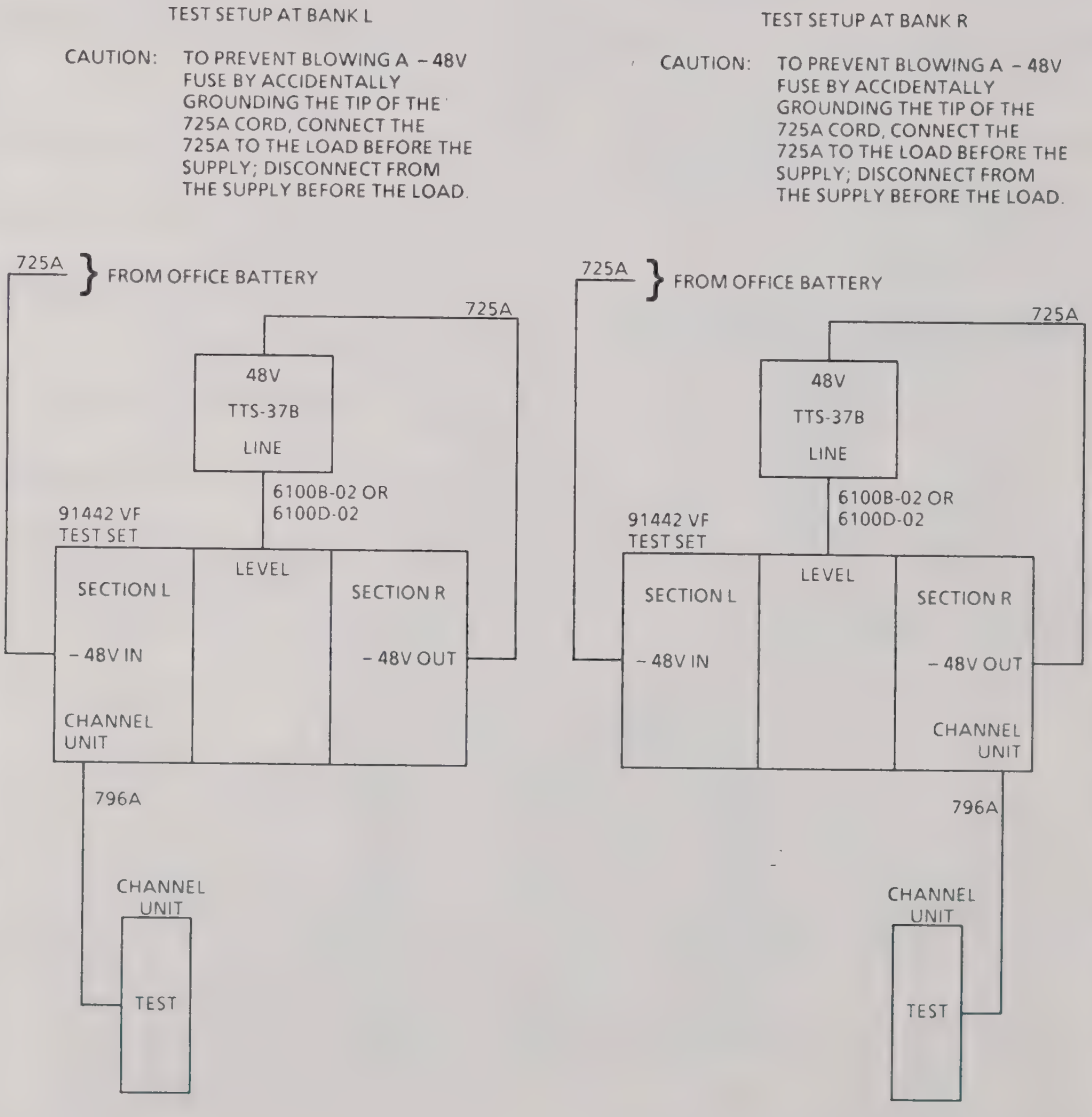


Figure 20. End-to-End Channel Performance Test with 91442 VF Test Set (Sheet 2 of 3).

Step	Procedure
NOTE:	Unless otherwise specified, perform all steps at each channel bank.
1	TEST SET CALIBRATION CHECK
1a	Set up test circuit shown in diagram, but do not connect 796A cord to 91442.
1b	Set controls on TTS-37B as follows: INPUT to 600 Ω TERM HOLD to OFF FILTER to 3 KC
1c	In Sections L and R of the 91442, set controls as follows: XMT ATTEN to 4.5 dB RCV ATTEN to 0 dB VF INTFC to 2W 600 Ω SEND LEVEL to 0 dB
1d	With a 6100C-02 Cord, connect together the T1-R1 DROP jacks in Sections L and R.
1e	In turn, set XMT-RCV switch on 91442 to position L-R and R-L. In each switch position, meter should read 0 ± 0.1 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
1f	Disconnect cord between T1-R1 DROP jacks.
2	CHANNEL UNIT SETUP
2a	At bank L in Section L of the 91442, set controls as follows: VF INTFC to channel unit impedance, 2W or 4WXMT ATTEN and RCV ATTEN to dB values strapped on channel unit (paragraph 4.31).
2b	At bank R, same as step 2a except in Section R of the 91442.
2c	Condition the channel for vf testing as described in paragraph 4.19.
2d	Connect 91442 to channel unit with 796A cord as shown in diagram.
3	VF LEVEL
3a	Set FILTER switch on TTS-37B to 3 KC.
3b	At each bank, set XMT-RCV switch to R-L. At bank L, meter should read 0 ± 0.3 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
3c	At each bank, set XMT-RCV switch to L-R. At bank R, meter should read 0 ± 0.3 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
4	IDLE NOISE
4a	At bank L, set XMT-RCV switch to R-L.
4b	At bank R, set XMT-RCV switch to L-R.
4c	At each bank, set FILTER switch on TTS-37B to C MSG. Meter reading should not exceed 23 dBrnc.
5	DISTORTION
5a	Connect TTS-37B to DISTN jack (instead of LEVEL jack) on 91442.
5b	Set FILTER switch on TTS-37B to C MSG.
5c	Set XMT-RCV switch to L-R.
5d	At bank L, in turn, set SEND LEVEL switch in Section L on 91442 to each of its five positions. Meter readings at bank R should not exceed the following: SEND LEVEL — Meter 0 dB — 57 dBrnc – 10 dB — 47 dBrnc – 20 dB — 37 dBrnc – 30 dB — 27 dBrnc – 40 dB — 23 dBrnc
5e	Set XMT-RCV switch to R-L.
5f	At bank R, in turn, set SEND LEVEL switch in Section R to each of its five positions. Meter readings at bank L should not exceed the values listed in step 5d.
5g	Restore SEND LEVEL switch to 0 dB.
5h	Reconnect TTS-37B to LEVEL jack on 91442.
6	IMPULSE NOISE
6a	Replace TTS-37B in test setup with TTS-58A Impulse Noise Counter.
6b	At bank L, set XMT-RCV switch to R-L.
6c	At bank R, set XMT-RCV switch to L-R.

Figure 20. End-to-End Channel Performance Test with 91442 VF Test Set (Sheet 3 of 3).

Step	Procedure
6d	Set controls on TTS-58A as follows: INPUT to 600 BRDG/TERM to TERM HOLD to OFF WTG to VOICE POWER to ON
6e	Set HI LEVEL and MID LEVEL 2-dB step attenuator switches to 20.
6f	Set REF LEVEL switches for LO LEVEL to 58 (50 + 8).
6g	Set all counters to 0000.
6h	Turn TIME control to 5 minutes.
6i	After 5 minutes, LO LEVEL counter should not read more than 0005.
6j	If other testing is to be done, replace TTS-58A in test setup with TTS- 37B.
7	CONCLUSION OF TEST
7a	Disconnect 796A cord from channel unit.
7b	Restore channel to service.
7c	If other channels are to be tested, return to step 2. Otherwise, disconnect the test setup.

Figure 21. Channel Frequency Response Test with 91442 VF Test Set (Sheet 1 of 2).

Description of Test. Channel frequency response is measured at 200 Hz and 3400 Hz relative to 1020 Hz, end-to-end in both directions.

Two-wire channel units should be strapped so that NBO capacitors and balance networks are disconnected from the hybrid. Otherwise, the response at 3400 Hz will be degraded.

Channel banks are designated "L" and "R" arbitrarily. As shown in the diagram, the channel units are connected to Section L (left) and R (right) of the 91442 VF Test Set at bank L and bank R, respectively.

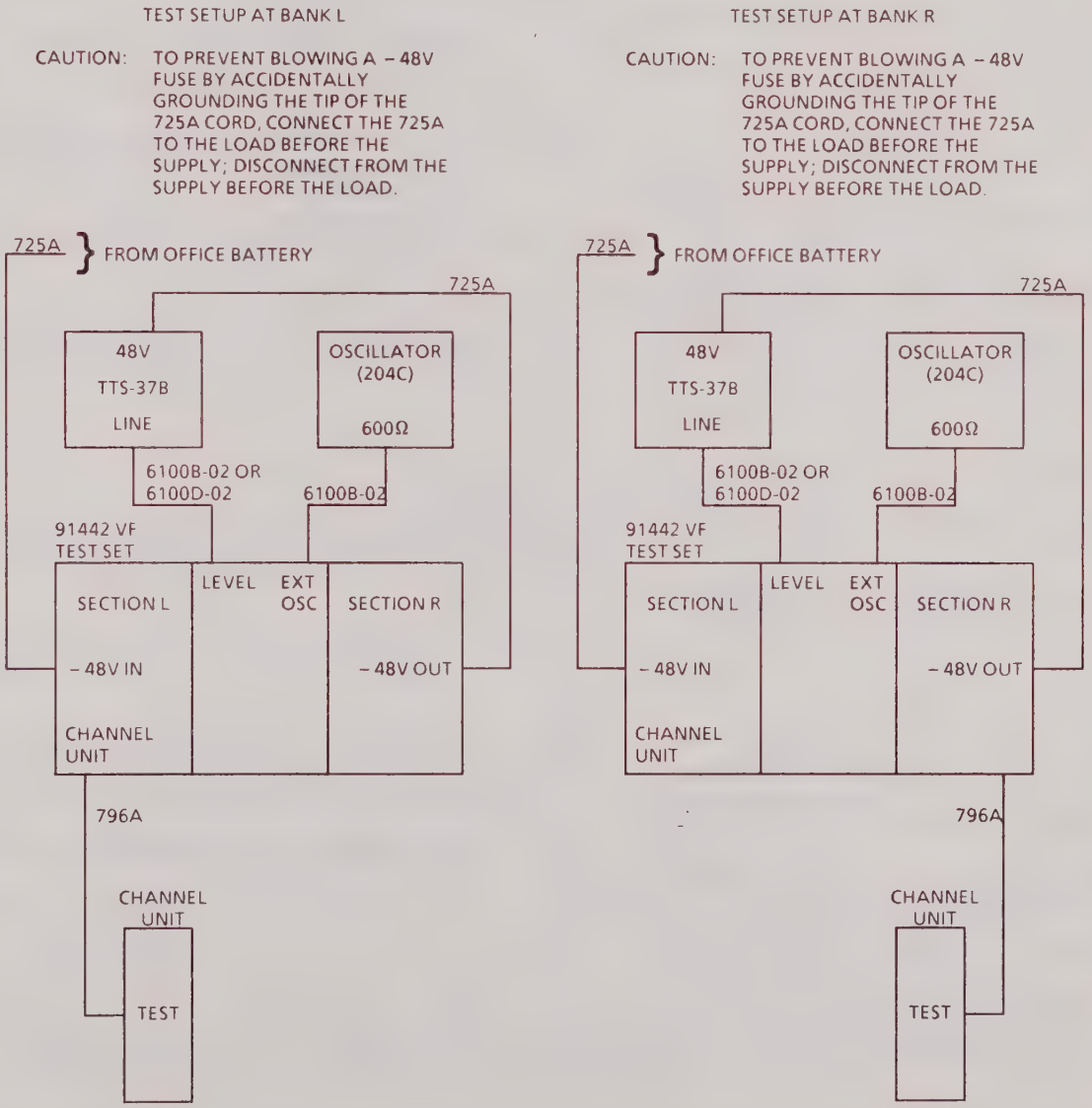


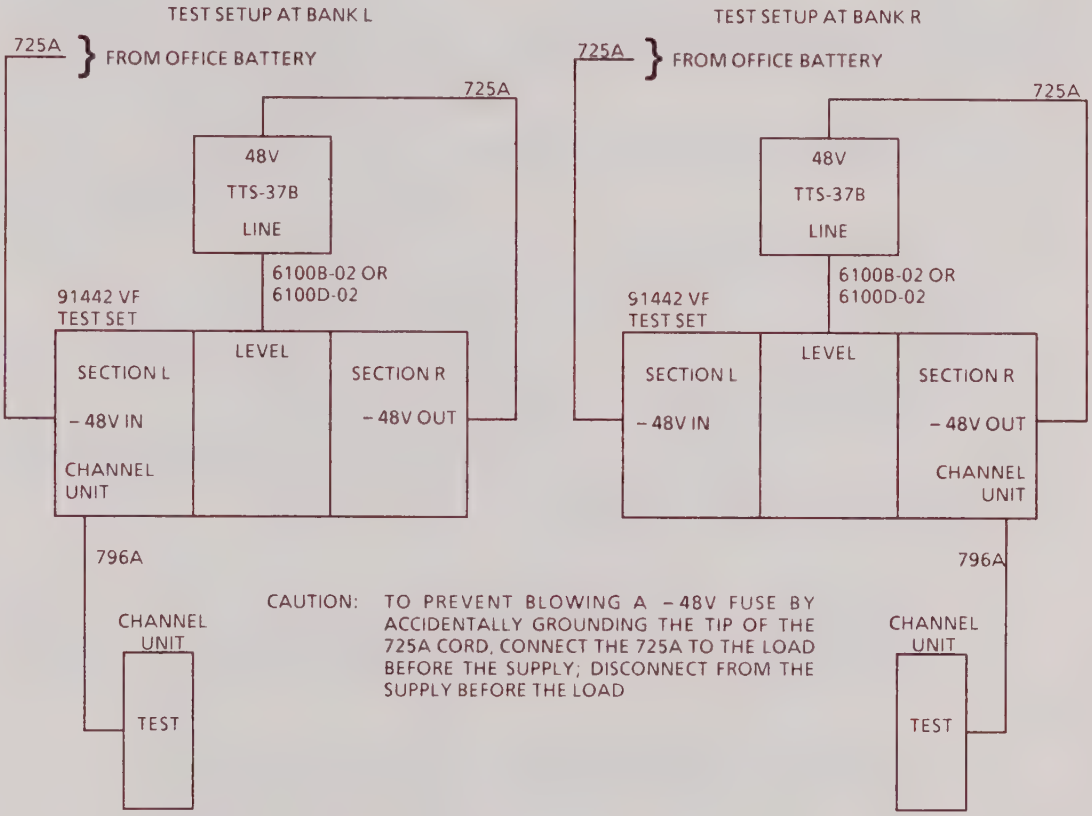
Figure 21. Channel Frequency Response Test with 91442 VF Test Set (Sheet 2 of 2).

Step	Procedure
1	TEST SET CALIBRATION CHECK AT EACH BANK
1a	Set up test circuit shown in diagram, but do not connect 796A cord to 91442. Also, do not plug 6100B-02 cord into EXT OSC jack on 91442.
1b	Set controls on TTS-37B as follows: INPUT to 600 Ω TERM HOLD to OFF FILTER to 3 KC
1c	In Sections L and R of the 91442, set controls as follows: XMT ATTEN to 4.5 dB RCV ATTEN to 0 dB VF INTFC to 2W 600 Ω SEND LEVEL to 0 dB
1d	With a 6100C-02 Cord, connect together the T1-R1 DROP jacks in Sections L and R.
1e	In turn, set XMT-RCV switch on 91442 to position L-R and R-L. In each switch position, meter should read 0 ± 0.1 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
1f	Disconnect cord between T1-R1 DROP jacks.
2	TEST TONE CALIBRATION AT EACH BANK
2a	Connect oscillator to 91442 as shown in diagram.
2b	Connect TTS-37B to T1-R1 DROP jack (instead of LEVEL jack) in Section L on 91442.
2c	Set FILTER switch on TTS-37B to 15 KC.
2d	Set XMT-RCV switch to L-R.
2e	Set oscillator frequency at 1020 Hz.
2f	Adjust oscillator output level for a meter reading of 0.0 dBm.
2g	In turn, set oscillator frequency at 200 Hz and 3400 Hz and record meter readings.
2h	Connect TTS-37B to LEVEL jack on 91442.
3	CHANNEL UNIT SETUP AT EACH BANK
3a	At bank L in Section L of the 91442, set controls as follows: VF INTFC to channel unit impedance, 2W or 4W XMT ATTEN and RCV ATTEN to dB values strapped on channel unit (paragraph 4.31)
3b	At bank R, same as step 3a except in Section R of the 91442.
3c	Condition the channel for vf testing as described in paragraph 4.19.
3d	Connect 91442 to channel unit with 796A cord as shown in diagram.
4	FREQUENCY RESPONSE, BANK L TO BANK R
4a	At each bank, set XMT-RCV switch to L-R.
4b	At bank L, set oscillator frequency at 1020 Hz and adjust output level for a meter reading of 0.0 dBm at bank R.
4c	At bank L, set oscillator frequency at 200 Hz and record meter reading at bank R.
4d	To correct for oscillator frequency response, algebraically subtract the 200 Hz level recorded in step 2g from the reading in step 4c; for example, -1.4 -(-0.3) = -1.1 dB.
4e	Repeat step 4c at 3400 Hz.
4f	Repeat step 4d at 3400 Hz.
4g	Based on the corrected readings of steps 4d and 4f, the frequency response at 200 Hz and 3400 Hz relative to 1020 Hz should be 0 to -3 dB.
NOTE:	If the channel unit at bank L or R is two-wire, the requirement at 200 Hz is 0 to -5 dB.
5	FREQUENCY RESPONSE, BANK R TO BANK L
5a	At each bank, set XMT-RCV switch to R-L.
5b	Same as step 4 except adjust oscillator at bank R and read meter at bank L.
6	CONCLUSION OF TEST
6a	Disconnect 796A cord from channel unit.
6b	Restore channel to service.
6c	If other channels are to be tested, return to step 3. Otherwise, disconnect the test setup.

Figure 22. Channel Crosstalk Test with 91442 VF Test Set (Sheet 1 of 2).

Description of Test. First, a 1020-Hz test tone is transmitted over the channel under test and VF receive level is checked. Then the test tone is transferred to the two adjacent channels, one at a time, and the crosstalk level in the channel under test is measured. ("Adjacent" means in the channel sampling sequence; see table on sheet 2.)

The direction of transmission in this test is from bank L to bank R. As shown in the diagram, the channel units are connected to Section L (left) and R (right) of the 91442 VF Test Set at bank L and bank R, respectively.



Step	Procedure
1	TEST SET CALIBRATION CHECK AT EACH BANK
1a	Set up test circuit shown in diagram, but do not connect 796A cord to 91442.
1b	Set controls on TTS-37B as follows: INPUT TO 600Ω HOLD TO OFF FILTER TO 3KC
1c	In sections L and R of the 91442, set controls as follows: XMT ATTEN TO 4.5 dB RCV ATTEN to 0 dB VF INTFC to 2W 600Ω SEND LEVEL to 0 dB
1d	With a 6100C-02 Cord, connect together the T1-R1 DROP jacks in Sections L and R.
1e	In turn, set XMT-RCV switch on 91422 to position L-R and R-L. In each switch position, meter should read 0 ± 0.1 dBm. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
1f	Disconnect cord between T1-R1 DROP jacks.

Figure 22. Channel Crosstalk Test with 91442 VF Test Set (Sheet 2 of 2).

Step	Procedure
1g	Set XMT-RCV switch on 91442 to L-R.
1h	Transfer test cord from LEVEL jack to CRSTLK jack on 91442.
1i	Set controls on TTS-37B as follows: INPUT to 600Ω FILTER to C MSG
2	Channel Status. Condition the channel under test and adjacent channels for VF testing as described in paragraph 4.19.
3	CHANNEL UNDER TEST AT BANK L
3a	In Section L of the 91442, set controls as follows: VF INTFC to channel unit impedance, 2W or 4W XMT ATTEN to dB value strapped on channel unit (paragraph 4.31)
3b	Connect 91442 to channel unit with 796A cord as shown in diagram.
4	CHANNEL UNDER TEST AT BANK R
4a	In Section R of the 91442, set controls as follows: VF INTFC to channel unit impedance, 2W or 4W RCV ATTEN to dB value strapped on channel unit (paragraph 4.31)

Step	Procedure
4b	Connect 91442 to channel unit with 796A cord as shown in diagram.
4c	Meter should read 0 dB. As required, change the settings of the RCV ATTEN switches in Section R to obtain a 0-dB reading. NOTE: If the meter cannot be operated in bridging mode, use – 9 dB as the reference level instead of 0 dB.
5	FIRST ADJACENT CHANNEL AT BANK L
5a	Same as step 3 except on the channel adjacent to the channel under test.
5b	At bank R, meter reading should not exceed 25 dBrnc (16 dBrnc if the reference level is – 9 dB).
6	SECOND ADJACENT CHANNEL AT BANK L Same as step 5.
7	CONCLUSION OF TEST
7a	Disconnect 796A cord from channel units.
7b	Restore channels to service.
7c	If other channels are to be tested, return to step 2. Otherwise, disconnect test setup.

Channel Sampling Sequence

DS1 Time Slot	Channel Number		
	D3 Sequence	D2 Sequence	D1D Sequence
1	1	12	1
2	2	13	13
3	3	1	2
4	4	17	14
5	5	5	3
6	6	21	15
7	7	9	4
8	8	15	16
9	9	3	5
10	10	19	17
11	11	7	6
12	12	23	18
13	13	11	7
14	14	14	19
15	15	2	8
16	16	18	20
17	17	6	9
18	18	22	21
19	19	10	10
20	20	16	22
21	21	4	11
22	22	20	23
23	23	8	12
24	24	24	24

4.36 As an example, assume that to compensate for 0.4-dB office wiring loss, the 6.3-dB transmit and receive attenuators in a near-end four-wire channel unit are strapped for 1.1 dB instead of 1.5 dB. If a -16 dBm test tone from the 91232 test set is applied to the channel unit at either end, the receive level measured at the other end should be +7.4 dBm. Moreover, if a 0.6-dB office wiring loss compensation is made in the far-end channel unit, the measured receive level should be +8.0 dBm.

4.37 In loop testing, the VF receive level is checked using a 0-dBm0 digital test tone. In this case, the receive level is not affected by the transmit channel unit attenuator setting.

4.38 **Performance Tests.** Test procedures using the 91232 test set are in Figures 23 (loop), 24 (end-to-end), 25 (frequency response), and 26 (crosstalk).

4.39 In the test setup diagrams of Figures 23 through 26, the interface with the channel unit under test is made through a 91443 Test Patch Panel (Figure 27). The CHANNEL UNIT receptacle connector on the 91443 is connected to the TEST receptacle connector on the channel unit with a 796A Patch Cord. VF circuits and E&M signaling leads toward the drop and toward the channel unit appear at the miniature normal-through tip-ring-sleeve DROP and CARR jacks, respectively. As required, the TRANSMIT and RECEIVE jacks on the 91232 are connected to the T-R or T1-R1 CARR jacks on the 91443 with a 6100C-02 Cord.

4.40 The channel unit VF interface described above uses three items: 796A cord, 91443 panel, and 6100C-02 cord. A 796B Test Cord may be used as an alternative with modifications to the test procedures as follows.

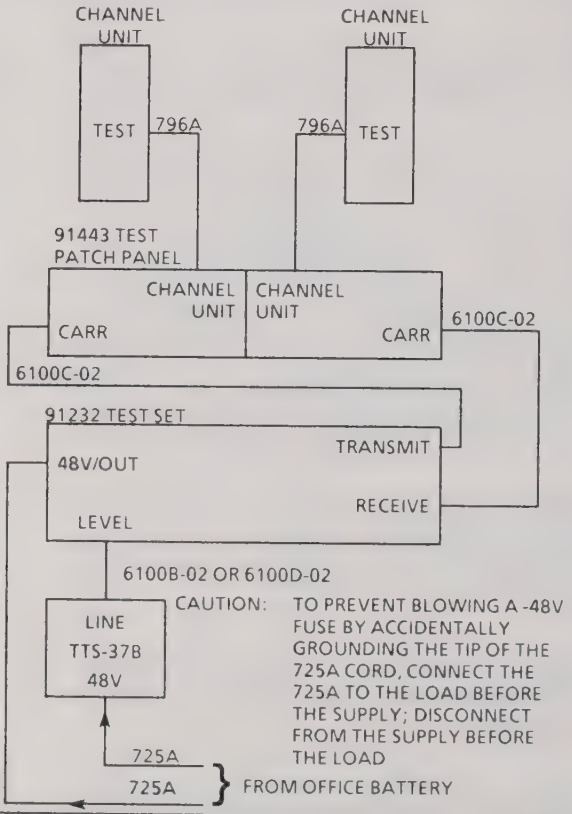
(a) With a four-wire channel unit, insert the T-R and T1-R1 plugs on the 796B cord in the TRANSMIT and RECEIVE jacks, respectively, on the 91232 test set.

(b) With a two-wire channel unit, insert the T1-R1 plug on the 796B cord in the TRANSMIT or RECEIVE jack on the 91232 test set, as specified.

Figure 23. Looped Channel Performance Test with 91232 Test and Alignment Set (Sheet 1 of 3).

Description of Test. The digital transmit signal of the channel bank is looped to the receive branch, linking the channels in pairs. See table on sheet 2. In Mode 1, the loop affects both digroups; in Modes 2 and 3, the digroups can be looped independently.

Each pair of channel units is tested in both directions for VF level, idle noise, and distortion. VF level is measured at the output of the receive channel unit, first with a digital test tone and then with an analog test tone.



Step	Procedure
1	DIGITAL LOOPBACK
1a	If the SYS ALM lamp on the alarm control unit is dark, create a system alarm, and then complete the next two steps within 10 seconds.
NOTE:	In Mode 1 or 3, the recommended way to initiate a system alarm is to open or short-circuit the digital receive line signal for a few seconds. If this is not convenient, or if the channel bank is Mode 2, momentarily unplug the alarm control unit, A or B as applicable.
1b	Depress and release ACO pushbutton. ACO indicator should light.
1c	Depress LOOP pushbutton. Green LOOP indicator should light.
2	TEST SETUP
2a	Set controls on TTS-37B as follows: INPUT to 600Ω BRDG HOLD to OFF FILTER to 3 KC
2b	Connect TTS-37B to 91232 test set as shown in diagram.
2c	Connect TTS-37B and 91232 test set to office battery as shown in diagram.
3	TEST TONE CALIBRATION, 91232 TEST SET
3a	Set TRANSMIT ATTENUATOR switch to 0 dB.
3b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress 2W 600Ω button.
3c	While depressing 600Ω CALIBRATION pushbutton, adjust adjacent OSC LEVEL control for meter reading of 0.0 dBm
3d	Release pushbutton.
4	CHANNEL UNIT PAIR
4a	Select the channel unit pair for testing; for example, 1A and 13A (digroup A, D3 sequence).
4b	Connect 91443 patch panel to selected channel units as shown in diagram.
4c	If the channel unit is 91405 DPT, insert an open plug in the T1-R1 DROP jack on the 91443 patch panel. (This prevents possible seizure of the office equipment in the next step.)
4d	If the channel unit is 91405 DPT, insert an open plug in the E&M CARR jack on the 91443 patch panel. (This enables the channel unit P relay.)
5	TRANSMIT CHANNEL UNIT
5a	Connect TRANSMIT jack on 91232 test set to left-hand CARR jack on 91443 patch panel: T-R jack if channel unit if four-wire or T1-R1 jack of channel unit is two-wire.
5b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.
6	RECEIVE CHANNEL UNIT
6a	Connect RECEIVE jack on 91232 test set to right-hand T1-R1 CARR jack on 91443 patch panel.
6b	In the RECEIVE set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.
7	RECEIVE LEVEL
7a	Set FILTER switch on TTS-37B to 3 KC.
7b	Set slide switch on receive unit to ON (up) position. Green TONE indicators should light.

Figure 23. Looped Channel Performance Test with 91232 Test and Alignment Set (Sheet 2 of 3).

Step	Procedure
7c	Meter reading (digital test tone) should be + 7 dBm (four-wire) or – 3 dBm (two-wire), or as described in paragraph 4.35 according to attenuator strapping on receive channel unit. The tolerance using this test setup is ± 0.4 dB. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
7d	Record level as a reference for idle noise test.
7e	Restore slide switch on receive unit to OFF (down) position. Green TONE indicator(s) should go dark.
7f	Meter reading (analog test tone) should be + 7 dBm (four-wire) or – 3 dBm (two-wire), or as described in paragraph 4.35 according to attenuator strapping on both transmit and receive channel units. The tolerance using this test setup is ± 0.6 dB. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
8	IDLE NOISE
8a	Set FILTER switch on TTS-37B to C MSG.
8b	Insert 600-ohm terminating plug (6000A-01) in EXTERNAL OSCILLATOR jack on 91232 test set. (This terminates the channel unit input and disconnects the test tone source.)
8c	Meter reading (dBrnc) should not exceed 23 dB higher than level (dBm) recorded in step 7d. For example, 20 dBrnc if the level is -3 dBm.
8d	Remove terminating plug from EXTERNAL OSCILLATOR jack.
9	DISTORTION
9a	Set FILTER switch on TTS-37B to C MSG.

Step	Procedure
9b	Connect TTS-37B to DISTN jack (instead of LEVEL jack) on 91232 test set.
9c	Set TRANSMIT ATTENUATOR switch on 91232 test set to 0 dB.
9d	While depressing DISTORTION REFERENCE pushbutton, adjust adjacent control for applicable meter reading as follows: Four-wire channel unit: 90 dBrnc (or 80 if 90 cannot be measured) Two-wire channel unit: 80 dBrnc
9e	Release pushbutton.
9f	With TRANSMIT ATTENUATOR switch at 0 dB, meter reading should not exceed: 57 dBrnc if the reference is 90 47 dBrnc if the reference is 80
9g	Set TRANSMIT ATTENUATOR switch to position A (-20 dB). Meter reading should not exceed: 37 dBrnc if the reference is 90 27 dBrnc if the reference is 80
9h	Set TRANSMIT ATTENUATOR switch to position B (-34 dB). Meter reading should not exceed: 29 dBrnc if the reference is 90 19 dBrnc if the reference is 80
9i	Reconnect TTS-37B to LEVEL jack on 91232 test set.
10	TEST SAME PAIR IN OPPOSITE DIRECTION
10a	Same as step 5 except connect to right-hand CARR jack in step 5a.

Looped Channel Pairs

D3 Sequence	D2 Sequence	D1D Sequence
1 and 13	1 and 2	1 and 7
2 and 14	3 and 4	2 and 8
3 and 15	5 and 6	3 and 9
4 and 16	7 and 8	4 and 10
5 and 17	9 and 10	5 and 11
6 and 18	11 and 12	6 and 12
7 and 19	13 and 14	13 and 19
8 and 20	15 and 16	14 and 20
9 and 21	17 and 18	15 and 21
10 and 22	19 and 20	16 and 22
11 and 23	21 and 22	17 and 23
12 and 24	23 and 24	18 and 24

Figure 23. Looped Channel Performance Test with 91232 Test and Alignment Set (Sheet 3 of 3).

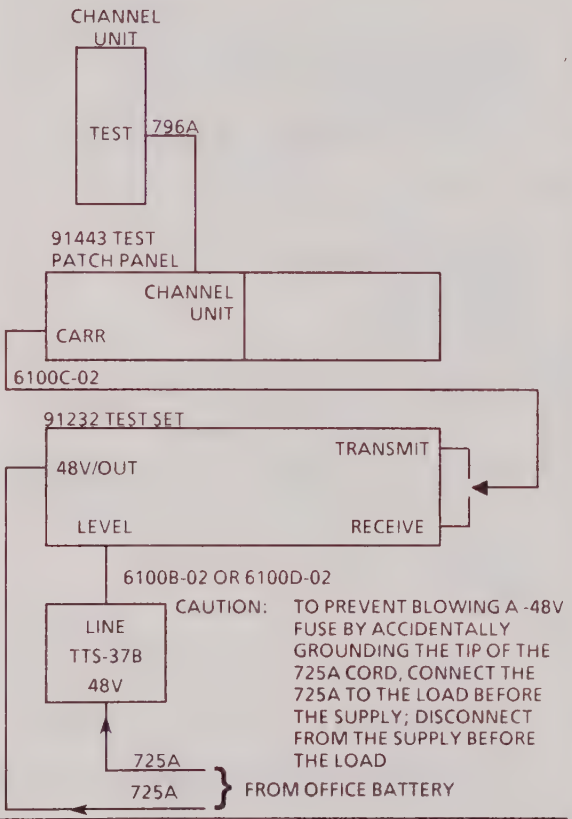
Step	Procedure
10b	Same as step 6 except connect to left-hand CARR jack in step 6a.
10c	Repeat steps 7, 8, and 9
11	COMPLETION OF TEST
11a	Disconnect 796A cord from channel unit.
11b	Check that NORM/BUSY switch on channel unit is set to NORM.
12	CHANNEL BANK MODE 1
12a	To test the next channel unit pair, return to step 4.
12b	Test channel unit pairs in succession through both digroups.
12c	When all channels have been tested in both directions, release the LOOP pushbutton.
13	CHANNEL BANK MODE 2 OR 3
13a	To test the next channel unit pair, return to step 4.
13b	Test channel unit pairs in succession through one digroup.
13c	When all channels of the digroup have been tested in both directions, release the LOOP pushbutton.
13d	To test the other digroup, do step 1 and then return to step 4.

Figure 24. End-to-End Channel Performance Test with 91232 Test and Alignment Set (Sheet 1 of 2).

Description of Test. The channel is tested in both directions for VF level, idle noise, distortion, and impulse noise.

Channel banks are designated "transmit" and "receive" according to the direction of transmission in the test.

TEST SETUP AT EACH BANK



Step	Procedure
1	TEST SETUP AT EACH BANK
1a	Set controls on TTS-37B as follows: INPUT to 600 Ω BRDG HOLD to OFF FILTER to 3 KC
1b	Connect TTS-37B to 91232 test set as shown in diagram.
1c	Connect TTS-37B and 91232 test set to office battery as shown in diagram.

Step	Procedure
2	TEST TONE CALIBRATION, 91232 TEST SET AT EACH BANK
2a	Set TRANSMIT ATTENUATOR switch to 0 dB.
2b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress 2W 600 Ω button.
2c	While depressing 600 Ω CALIBRATION pushbutton, adjust adjacent OSC LEVEL control for meter reading of 0.0 dBm.
2d	Release pushbutton.
3	CHANNEL UNIT AT EACH BANK
3a	Condition the channel for VF testing as described in paragraph 4.19.
3b	If the channel unit is 91405 DPT, insert an open plug in the T1-R1 DROP jack on the 91443 patch panel. (This prevents possible seizure of the office equipment in the next step.)
3c	Connect channel unit to 91443 patch panel as shown in diagram.
4	TEST SETUP AT TRANSMIT BANK
4a	Connect TRANSMIT jack on 91232 test set to CARR jack on 91443 patch panel: T-R jack if channel unit is four-wire or T1-R1 jack if channel unit is two-wire.
4b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.
5	TEST SETUP AT RECEIVE BANK
5a	Connect RECEIVE jack on 91232 test set to T1-R1 CARR jack on 91443 patch panel.
5b	In the RECEIVE set of CHANNEL TYPE SELECT pushbuttons, depress applicable button.
6	RECEIVE LEVEL
6a	Meter reading at the receive bank should be + 7 dBm (four-wire) or – 3 dBm (two-wire) or as described in paragraph 4.35 according to channel unit attenuator strapping. The tolerance using this test setup is ± 0.6 dB. (Tolerance does not include an allowance for meter accuracy; see paragraph 4.11.)
6b	Record the level as a reference for noise measurements.

Figure 24. End-to-End Channel Performance Test with 91232 Test and Alignment Set (Sheet 2 of 2).

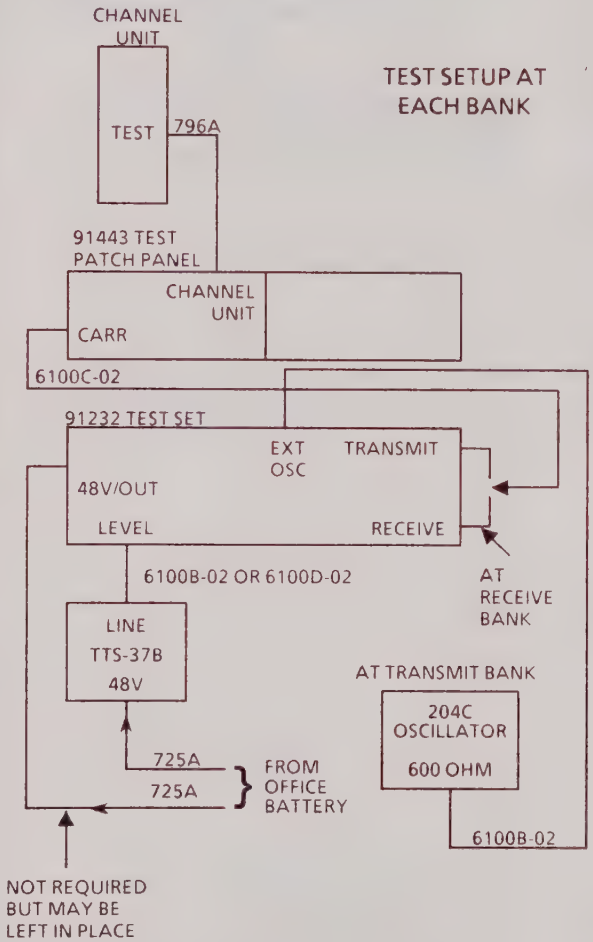
Step	Procedure
7	IDLE NOISE
7a	At the transmit bank, insert 600-ohm terminating plug (6000A-01) in EXTERNAL OSCILLATOR jack on 91232 test set. (This terminates the channel unit input and disconnects the test tone source.)
7b	At the receive bank, set FILTER switch on TTS-37B to C MSG.
7c	Meter reading (dBrnc) at the receive bank should not exceed 23 dB higher than level (dBm) recorded in step 6b. For example, 20 dBrnc if the level is -3 dBm.
7d	At the transmit bank, remove terminating plug from EXTERNAL OSCILLATOR jack.
8	DISTORTION
8a	At the transmit bank, set TRANSMIT ATTENUATOR switch on 91232 test set to 0 dB.
8b	At the receive bank, connect TTS-37B to DISTN jack (instead of LEVEL jack) on 91232 test set.
8c	Set FILTER switch on TTS-37B to C MSG.
8d	At the receive bank, while depressing DISTORTION REFERENCE pushbutton, adjust adjacent control for applicable meter reading as follows: Four-wire channel unit: 90 dBrnc (or 80 if 90 cannot be measured) Two-wire channel unit: 80 dBrnc
8e	Release pushbutton.
NOTE:	In the next three steps, the TRANSMIT ATTENUATOR switch is on the 91232 test set at the transmit bank; meter readings are at the receive bank.
8f	With TRANSMIT ATTENUATOR switch set at 0 dB, meter reading should not exceed: 57 dBrnc if the reference is 90 47 dBrnc if the reference is 80
8g	Set TRANSMIT ATTENUATOR switch to position A (-20 dB). Meter reading should not exceed: 37 dBrnc if the reference is 90 27 dBrnc if the reference is 80
8h	Set TRANSMIT ATTENUATOR switch to position B (– 34 dB). Meter reading should not exceed: 29 dBrnc if the reference is 90 19 dBrnc if the reference is 80
8i	At the receive bank, connect TTS-37B to LEVEL jack on 91232 test set.
9	IMPULSE NOISE
9a	At the transmit bank, insert 600-ohm terminating plug (6000A-01) in EXTERNAL OSCILLATOR jack on 91232 test set.
9b	At the receive bank, replace TTS-37B in test setup with TTS-58A Impulse Noise Counter.
9c	Set controls on TTS-58A as follows: INPUT to 600 BRDG/TERM to BRDG HOLD to OFF WTG to VOICE POWER to ON
9d	Set HI LEVEL and MID LEVEL 2-db step attenuator switches to 20.
9e	Set REF LEVEL switches for LO LEVEL to 58 + level recorded in step 6b; for example 55 if the level is – 3 (or 56 if 55 is not available).
9f	Set all counters to 0000.
9g	Turn TIME control to 5 minutes.
9h	After 5 minutes, LO LEVEL counter should not read more than 0005.
9i	Replace TTS-58A in test setup with TTS-37B.
9j	At the transmit bank, remove terminating plug from EXTERNAL OSCILLATOR jack.
10	TEST CHANNEL IN OPPOSITE DIRECTION. Repeat steps 4 through 9 with the channel bank designations exchanged; that is, the transmit bank becomes the receive bank, and vice versa.
11	CONCLUSION OF TEST
11a	Disconnect 796A cords from channel units.
11b	Restore channel to service.
11c	If other channels are to be tested, return to step 3. Otherwise disconnect the test setup

Figure 25. Channel Frequency Response Test with 91232 Test and Alignment Set (Sheet 1 of 2).

DESCRIPTION OF TEST. Channel frequency response is measured at 200 Hz and 3400 Hz relative to 1020 Hz, end-to-end in both directions.

Two-wire channel units should be strapped so that NBO capacitors or balance networks are disconnected from the hybrid. Otherwise, the response at 3400 Hz will be degraded.

Channel banks are designated "transmit" and "receive" according to the direction of transmission in the test.



CAUTION: TO PREVENT BLOWING A -48V FUSE BY ACCIDENTALLY GROUNDING THE TIP OF THE 725A CORD, CONNECT THE 725A TO THE LOAD BEFORE THE SUPPLY; DISCONNECT FROM THE SUPPLY BEFORE THE LOAD

Step	Procedure
1	TEST SETUP AT EACH BANK
1a	Set controls on TTS-37B as follows: INPUT to 600 Ω BRDG HOLD to OFF FILTER to 3 KC
1b	Connect TTS-37B to 91232 test set as shown in diagram.
1c	Connect TTS-37B and 91232 test set to office battery as shown in diagram.
2	TEST TONE CALIBRATION AT TRANSMIT BANK
2a	Connect oscillator to 91232 test set as shown in diagram.
2b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress 2W 600 ohm button.
2c	Set oscillator frequency at 1020 Hz.
2d	While depressing 600 CALIBRATION pushbutton, adjust oscillator output level for a meter reading of 0.0 dBm.
2e	Set oscillator frequency at 200 Hz. Depress 600 CALIBRATION pushbutton and read meter. Record the reading.
2f	Repeat step 2e at 3400 Hz.
3	CHANNEL UNIT AT EACH BANK
3a	Condition the channel for VF testing as described in paragraph 4.19.
3b	If the channel unit is 91405 DPT, insert an open plug in the T1-R1 DROP jack on the 91443 patch panel. (This prevents possible seizure of the office equipment in the next step.)
3c	Connect channel unit to 91443 patch panel as shown in diagram.
4	TEST SETUP AT TRANSMIT BANK
4a	Connect TRANSMIT jack on 91232 test set to CARR jack on 91443 patch panel: T-R jack if channel unit is four-wire or T1-R1 jack if channel unit is two-wire.
4b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.

Figure 25. Channel Frequency Response Test with 91232 Test and Alignment Set (Sheet 2 of 2).

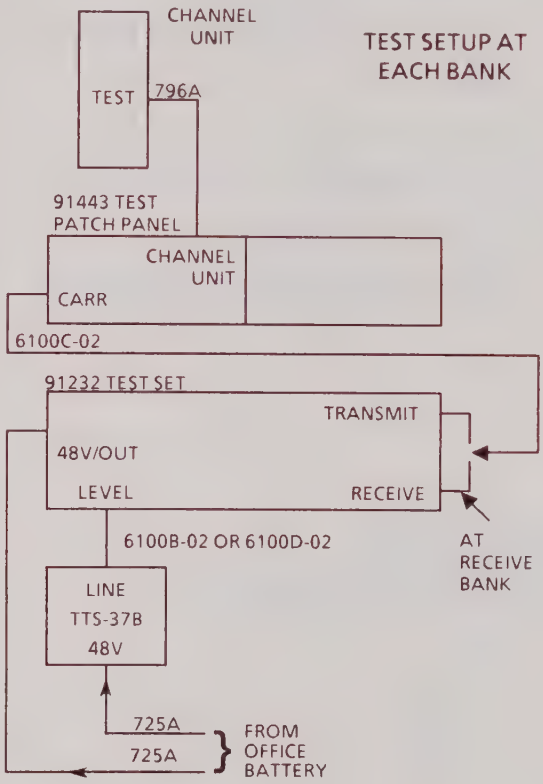
Step	Procedure
5	TEST SETUP AT RECEIVE BANK
5a	Connect RECEIVE jack on 91232 test set to T1-R1 CARR jack on 91443 patch panel.
5b	In the RECEIVE set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.
6	REFERENCE LEVEL AT 1020 HZ
6a	Set oscillator frequency at 1020 Hz.
6b	Adjust oscillator output level for a meter reading at the receive bank of + 7.0 dBm (four-wire channel unit) or – 3.0 dBm (two-wire channel unit).
7	FREQUENCY RESPONSE
7a	Set oscillator frequency at 200 Hz and record meter reading at receive bank.
7b	To correct for oscillator response, algebraically subtract the 200-Hz level recorded in step 2e from the reading in step 7a; for example, + 5.5 – (– 0.2) = + 5.7.
7c	Repeat step 7a at 3400 Hz.
7d	Repeat step 7b at 3400 Hz.
7e	Based on the corrected readings of steps 7b and 7d, the frequency response at 200 Hz and 3400 Hz relative to 1020 Hz should be 0 to – 3 dB.
	NOTE: If the transmit or receive channel unit is two-wire, the requirement at 200 Hz is 0 to – 5 dB.
8	TEST CHANNEL IN OPPOSITE DIRECTION Repeat steps 2 through 7 with the channel bank designations exchanged; that is, the transmit bank becomes the receive bank, and vice versa.
9	CONCLUSION OF TEST
9a	Disconnect 796A cord from channel unit.
9b	Restore channel to service.
9c	If other channels are to be tested, return to step 3. Otherwise, disconnect the test setup.

Figure 26. Channel Crosstalk Test with 91232 Test and Alignment Set (Sheet 1 of 2).

DESCRIPTION OF TEST. First, a 1025-Hz test tone is transmitted over the channel under test and the VF receive level is checked. Then, the test tone is transferred to two adjacent channels, one at a time, and the crosstalk level in the channel under test is measured.

"Adjacent" means in the channel sampling sequence; see table on sheet 2.

Channel banks are designated "transmit" and "receive" according to the direction of transmission in the test.



CAUTION: TO PREVENT BLOWING A -48V FUSE BY ACCIDENTALLY GROUNDING THE TIP OF THE 725A CORD, CONNECT THE 725A TO THE LOAD BEFORE THE SUPPLY; DISCONNECT FROM THE SUPPLY BEFORE THE LOAD.

Step	Procedure
1	TEST SETUP AT EACH BANK
1a	Set controls on TTS-37B as follows: INPUT to 600 BRDG HOLD to OFF FILTER to 3 KC
1b	Connect TTS-37B to 91232 test set as shown in diagram.
1c	Connect TTS-37B and 91232 test set to office battery as shown in diagram.
2	TEST TONE CALIBRATION, 91232 TEST SET AT EACH BANK
2a	Set TRANSMIT ATTENUATOR switch to 0 dB.
2b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress 2W 600 button.
2c	While depressing 600 CALIBRATION pushbutton, adjust adjacent OSC LEVEL control for meter reading of 0.0 dBm.
2d	Release pushbutton.
3	CHANNEL STATUS Condition the channel under test and the adjacent channels for VF testing as described in paragraph 4.19.
4	TEST SETUP AT TRANSMIT BANK
4a	Connect channel unit under test to 91443 patch panel as shown in diagram.
4b	Connect TRANSMIT jack on 91232 test set to CARR jack on 91443 patch panel: T-R jack if channel unit is four-wire or T1-R1 jack if channel unit is two-wire.
4c	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress the applicable pushbutton.
5	TEST SETUP AT RECEIVE BANK
5a	If the channel unit is 91405 DPT, insert an open plug in the T1-R1 DROP jack on the 91443 patch panel. (This prevents possible seizure of the office equipment in the next step.)
5b	Connect 91443 patch panel to channel unit under test as shown in diagram.

Figure 26. Channel Crosstalk Test with 91232 Test and Alignment Set (Sheet 2 of 2).

Step	Procedure
5c	Connect RECEIVE jack on 91232 test set to T1-R1 CARR jack on 91443 patch panel.
5d	In the RECEIVE set of CHANNEL TYPE SELECT pushbuttons, depress the applicable button.
6	VF LEVEL AT RECEIVE BANK
6a	Set FILTER switch on TTS-37B to 3 KC.
6b	Meter reading at the receive bank should be + 7 dBm (four-wire) or – 3 dBm (two-wire) or as described in paragraph 4.35 according to channel unit attenuator strapping.
6c	Record level as a reference for crosstalk measurements.
6d	Set FILTER switch on TTS-37B to C MSG.
7	FIRST ADJACENT CHANNEL AT TRANSMIT BANK
7a	Connect TRANSMIT jack on 91232 test set to CARR jack on 91443 patch panel: T-R jack if channel unit is four-wire or T1-R1 jack if channel unit is two-wire.
7b	In the TRANSMIT set of CHANNEL TYPE SELECT pushbuttons, depress the applicable pushbutton.
7c	Connect 91443 patch panel to channel unit as shown in diagram.
7d	At the receive bank, meter reading (dBrnc) should not exceed 25 dB higher than level (dBm) recorded in step 6c. For example, 22 dBrnc if the level is – 3 dBm.
8	SECOND ADJACENT CHANNEL AT TRANSMIT BANK Same as Step 7.
9	CONCLUSION OF TEST
9a	Disconnect 796A cord from channel units.
9b	Restore channels to service
9c	If other channels are to be tested, return to step 3. Otherwise, disconnect the test setup.

Channel Sampling Sequence

DS1 Time Slot	Channel Number		
	D3 Sequence	D2 Sequence	D1D Sequence
1	1	12	1
2	2	13	13
3	3	1	2
4	4	17	14
5	5	5	3
6	6	21	15
7	7	9	4
8	8	15	16
9	9	3	5
10	10	19	17
11	11	7	6
12	12	23	18
13	13	11	7
14	14	14	19
15	15	2	8
16	16	18	20
17	17	6	9
18	18	22	21
19	19	10	10
20	20	16	22
21	21	4	11
22	22	20	23
23	23	8	12
24	24	24	24

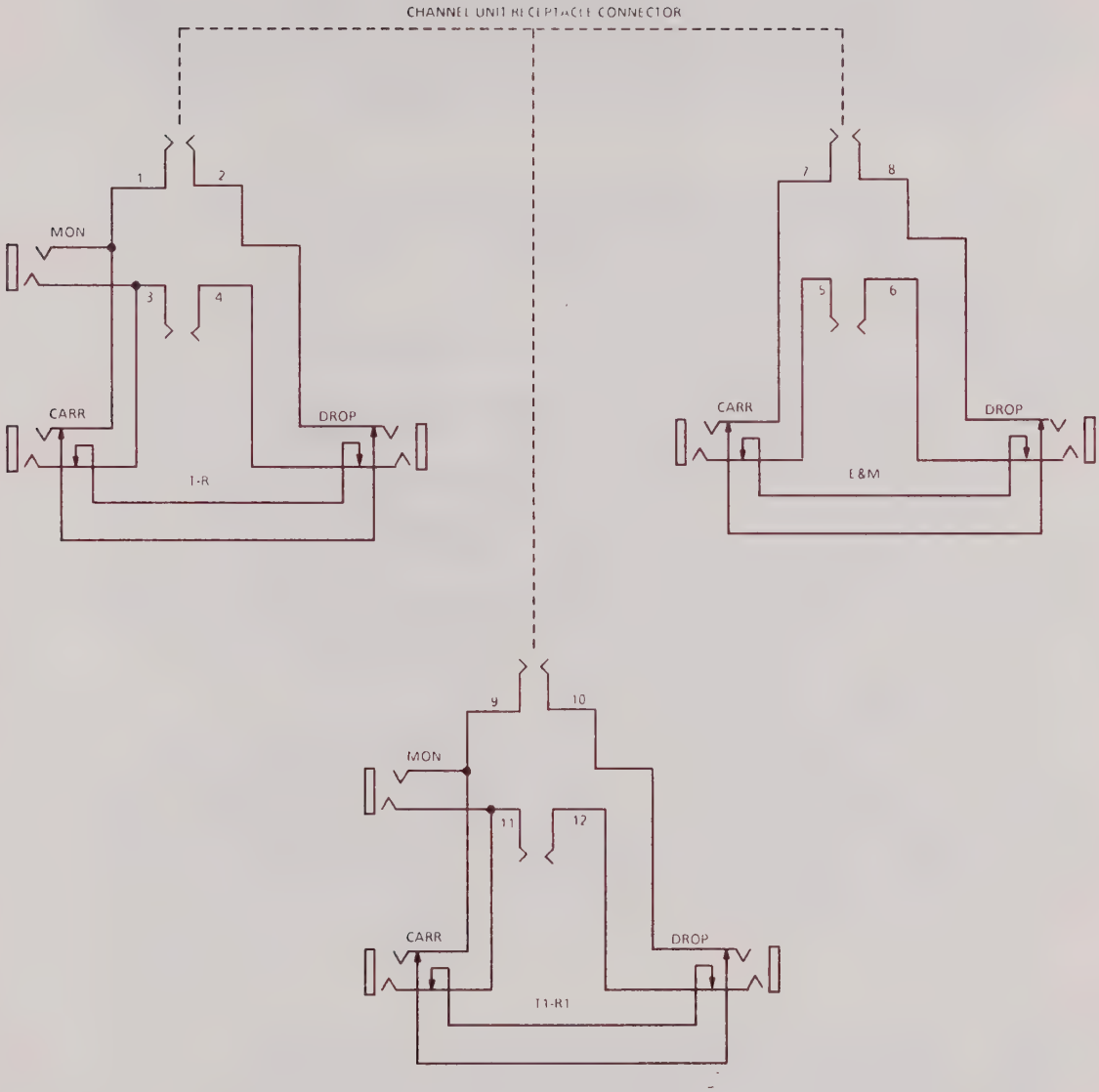


Figure 27. 91443 Test Patch Panel.

5. SYSTEM ALARM TEST

5.01 A system alarm originating at the local channel bank results in a system alarm at the remote channel bank also. Fifteen ± five seconds after the alarm condition clears at the local bank, both banks restore to normal. Figure 28 is a procedure for verifying that the system alarm restoral at the local and remote banks is coordinated.

Figure 28. System Alarm Restoral Test.

Description of Test. With the system operating end-to-end, a system alarm is forced and the alarm is held by depressing the LOOP pushbutton. Then, the LOOP pushbutton is released, and the time difference between restoral at each end of the system is observed. The test should be performed, in turn, on each alarm control unit of both banks.

Step	Procedure
1	INITIATE SYSTEM ALARM AT LOCAL BANK
1a	Create a system alarm and then complete the next two steps within 10 seconds.
NOTE:	In Mode 1 or 3, the recommended way to initiate a system alarm is to open or short-circuit the digital receive line signal for a few seconds. If this is not convenient, or if the channel bank is Mode 2, momentarily unplug the alarm control unit, A or B as applicable.
1b	Depress and release ACO pushbutton. ACO indicator should light.
1c	Depress LOOP pushbutton. Green LOOP indicator should light.
2	AT THE REMOTE BANK
2a	SYS ALM lamp and LOC indicator should be lighted.
2b	Depress and release ACO pushbutton. ACO indicator should light.
3	SYSTEM ALARM RESTORAL
3a	Release the LOOP pushbutton.
3b	After a delay of 15 ± 5 seconds, the SYS ALM lamps at the local bank and remote bank should go dark within 1 second of each other.

6. TROUBLESHOOTING

6.01 The primary method of troubleshooting the 9004B channel bank is by systematic replacement of plug-in units according to observed or measured symptoms. After a unit is replaced, test as necessary to verify normal operation. If a replacement unit does not clear the trouble, remove it and plug the original unit back into the shelf before continuing with the troubleshooting.

6.02 Field repair of plug-in units is not recommended. Defective units should be returned as described under Factory Repair Service in Part 3.

CAUTION

IF CONTINUITY CHECKS OF THE CHANNEL BANK SHELF WIRING ARE REQUIRED, TURN OFF THE –48V POWER AND UNPLUG ALL CHANNEL UNITS AND COMMON EQUIPMENT UNITS. THERE ARE TWO REASONS FOR THIS PRECAUTION. ONE IS THE POSSIBILITY OF DAMAGING ONE OR MANY UNITS IN THE SHELF BY SHORTING ADJACENT PINS ON THE SHELF CONNECTORS. THE OTHER IS THE VOLTAGE ON THE MULTIMETER LEADS: ON THE HIGHER OHM RANGES, THIS VOLTAGE EXCEEDS THE RATINGS OF MANY INTEGRATED CIRCUITS.

Common Equipment

6.03 By analysis of alarm indications with the channel banks operating in the end-to-end and looped modes, trouble usually can be isolated to one terminal or to one direction of transmission. Table 6 is a summary of the alarm indications resulting from failure of a common equipment unit or a repeater unit. Figure 29 is a troubleshooting chart based on similar information.

NOTE: The alarm LEDs on the 91418 TREU include Loss of Signal (LOS), Alarm Indication Signal (AIS), and Out of Frame (OOF). When multiple alarms are present, only one LED lights at a time. The highest alarm LED will always light. The priority is LOS, AIS, and OOF.

Channel Units

6.04 A defective channel unit usually will not be detected by the bank alarm circuits. If improper VF transmission or signaling is evident on one channel only, isolating the defective unit is obviously not difficult. However, a shorted bus or a defective codec in one channel unit possibly could affect many or all channels. The defective unit can best be located by unplugging the channel units until the problem disappears. To ensure

that other channel units are not involved, reinsert the channel units one by one, observing that the problem does not recur.

6.05 The 91449 Channel Unit Extender makes the channel unit interior accessible for inspection and test with power on. VF and signaling circuits pass through telephone-type jacks; supervisory and power leads have pin jack test points. See Figure 30.

6.06 A data channel unit with its drop disconnected transmits all data bits as 0's. If 24 channels are equipped with data channel units and all drops are disconnected, the resultant bit 2 suppression will produce a remote alarm at the distant terminal.

91445 Signaling Path Test Set

6.07 Voice frequency transmission and signaling/supervision (but not pulsing) over the system on any channel can be checked by replacing the channel unit at one or both banks with a 91445 Signaling Path Test Set (SPTS). Important differences in dash numbers and model numbers are as follows:

(a) Receive signaling indicators on the 91445-01 light red for busy; on the 91445-02 they light green for idle.

(b) Four-wire transmit and receive pairs on Model 2 go through the VF TEST receptacle connector to the drop.

(c) A and B signaling channels on Model 2 can be independent or paralleled (strapping option).

6.08 **VF Test.** Performance test procedures in Part 4 can be done with the channel unit replaced by an SPTS. The VF transmit/receive levels at the VF TEST receptacle connector on the SPTS are -16/+7 dBm. If the test setup has a 91442 VF Test Set, set both the XMT ATTEN and RCV ATTEN toggle switches on the 91442 at 1.5 dB.

6.09 **Signaling Tests.** Switches and LED's on the SPTS control and monitor the state of the A and B signaling channels. The A or B channel is busy when the switch is up and idle when it is down. As mentioned before, the LED's light red for busy on the 91445-01 SPTS and green for idle on the 91445-02.

6.10 If the Model 1 SPTS is in an end-to-end test with a channel unit that normally receives the same signaling information on the A and B signaling channels (as most trunk channel units do), the switches on the SPTS should always be operated simultaneously to the same position. The signaling state decoded by the channel unit alternates every 750 us when the switches are not in the same position.

6.11 The Model 2 SPTS has a strapping plug to enable independent or parallel signaling channels. In the situation described above, insert the

strapping plug in the COM position, set one XMT switch up, and control both signaling channels with the other switch. Strapping plug position SEP provides independent control of the signaling channels.

Pulsing Tests

6.12 Dial pulse signaling distortion is measured on an end-to-end basis by performance test procedures in the Practices for individual channel unit types; see Part 3.

6.13 For end-to-end testing, substituting a channel unit of the same type is a logical troubleshooting step. As an additional step, substituting a 91445 Signaling Path Test Set for the channel unit in question will enable you to detect signaling malfunctions, particularly if they are marginal or intermittent.

DC Voltage Measurements

6.14 The 91425 Power Supply Unit has + 5V, -5V, + 12V, and -12V pin jack test points. With only a 91425 unit and a 91436 unit plugged into the bank, voltages measured with a digital voltmeter should be within the following ranges:

(a) + 5V or -5V to GND: 5.0 to 5.6 Vdc.

(b) + 12V or -12V to GND: 12.0 to 13.0 Vdc.

6.15 With the channel bank fully equipped, the following voltage ranges are applicable:

(a) + 5V or -5V to GND: 4.75 to 5.25 Vdc.

(b) + 12V or - 12V to GND: 11.4 to 12.6 Vdc.

Repeatered Line

6.16 In troubleshooting a system, the repeatered line or other facility can be checked on a sectional basis by looping the DS1 or DS1C digital line signal at various patching locations. With the channel bank in system alarm condition (SYS ALM and ACO lighted), depressing the TMB HOLD pushbutton maintains the system alarm, activates the TMB function, and forces bit 2 suppression. Now, when the digital signal is looped back, one of the following indications should be observed:

(a) If the facility is good out and back, the LOC indicator will be dark, but the REM indicator will be lighted because of bit 2 suppression.

(b) If there is a failure in either direction, the LOC indicator will be lighted.

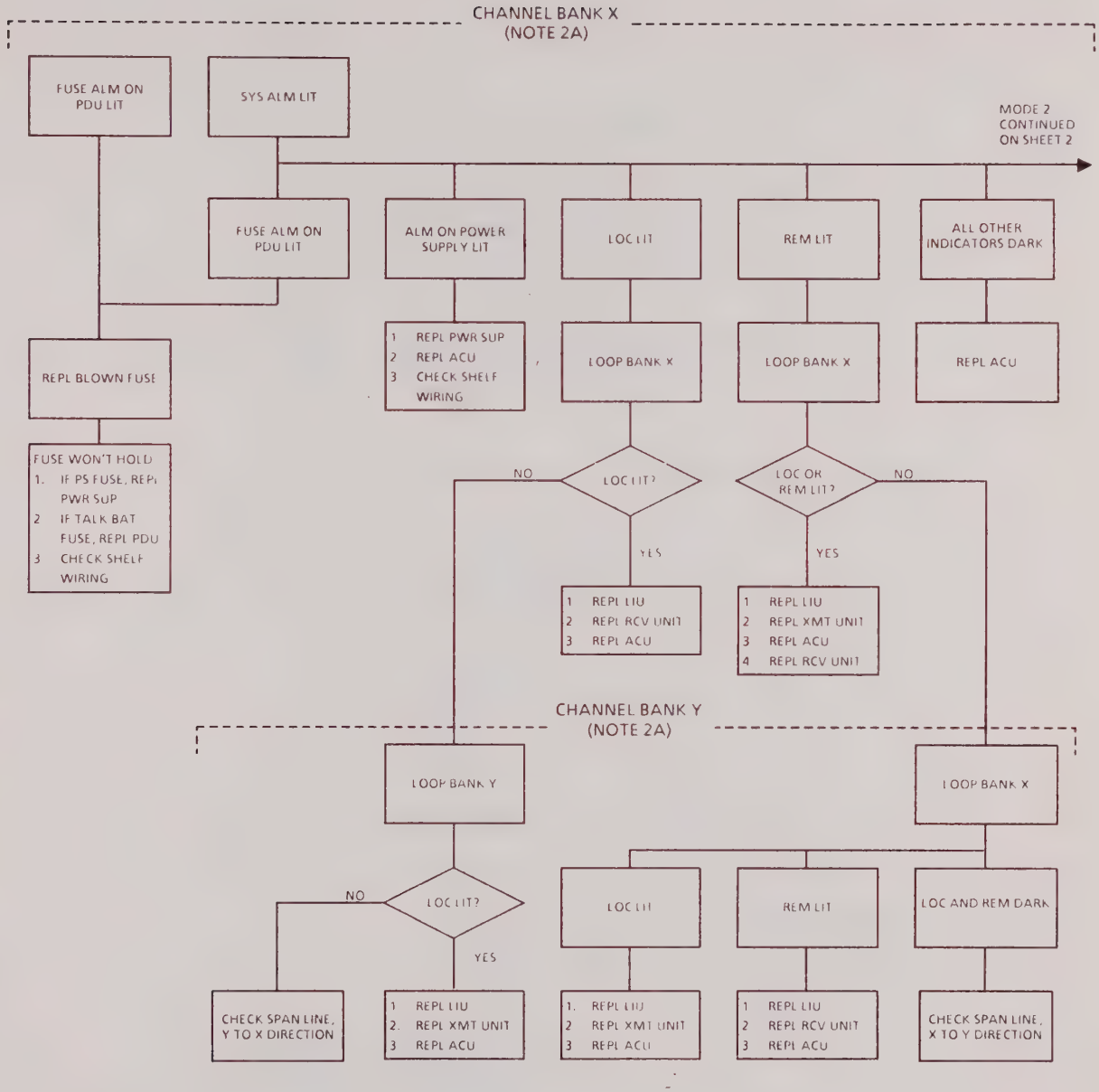
Table 6. Alarm Indications with Channel Bank in End-to-End and Looped Modes.

FAILURE AT CHANNEL BANK X	INDICATORS LIGHTED (Note 1)			
	CHANNEL BANK X		CHANNEL BANK Y	
	END-TO-END	LOOPED	END-TO-END	LOOPED
POWER	ALM	ALM	LOC	--
TRANSMIT BRANCH	REM	LOC OR REM	LOC	--
RECEIVE BRANCH	LOC	LOC	REM	--
REPEATER, X TO Y DIRECTION (Note 2)	REM	--	LOC	--
REPEATER, BOTH DIRECTIONS	LOC	--	LOC	--

Notes:

1. Indicators. When the LOC, REM, or ALM indicator is lighted, the SYS ALM lamp will be lighted also.

2. Repeater Failure. When the channel bank is looped, the cable equalizers on the back of the shelf are not included in the loop. To verify that the trouble is not in channel bank X, loop the signal as explained in paragraph 6.16.



NOTES:

1. CHANNEL BANK X AND Y ARE ARBITRARY DESIGNATIONS FOR THE CHANNEL BANKS AT OPPOSITE ENDS OF THE SYSTEM, OPERATING IN EITHER MODE 2 OR 3

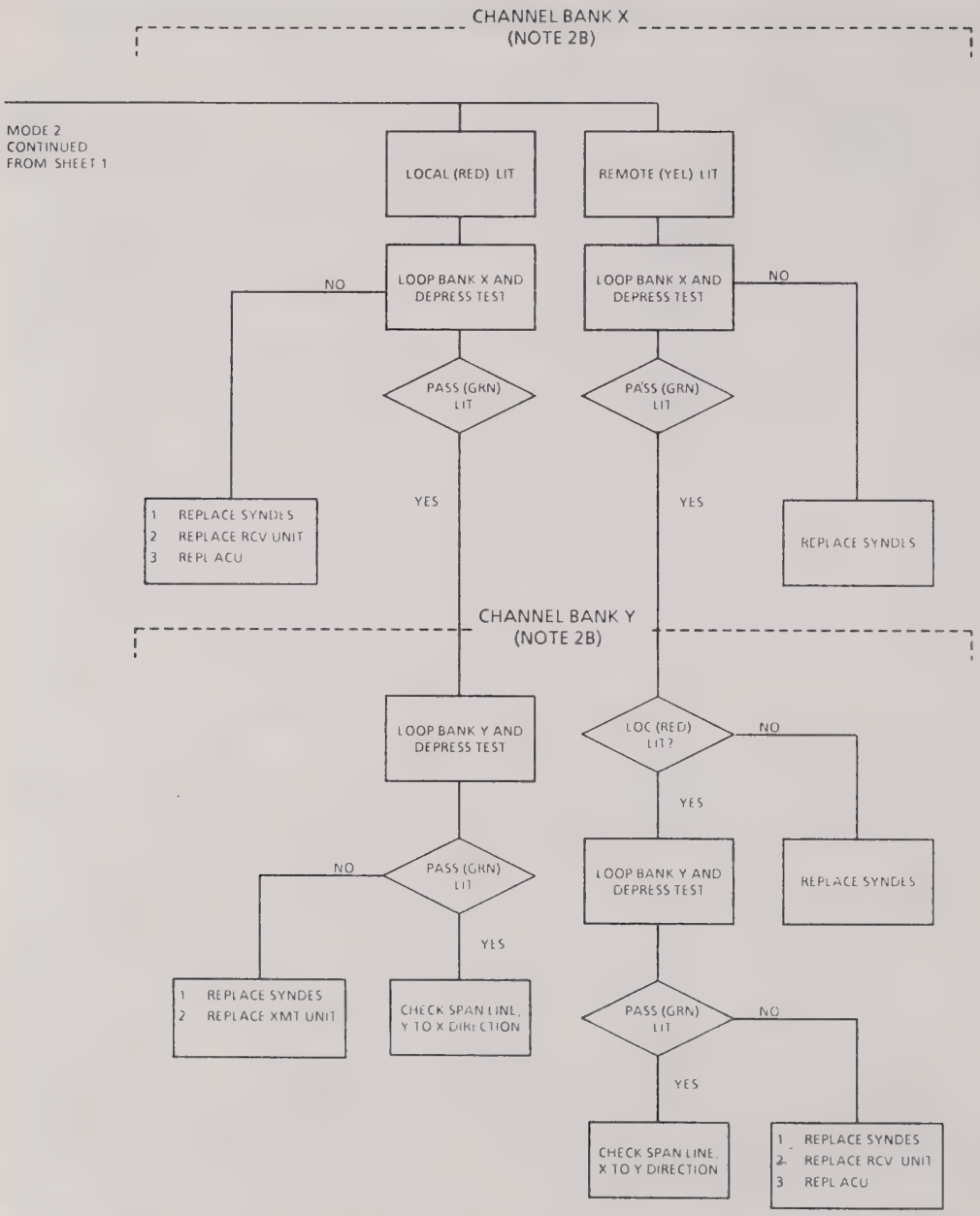
2. CONTROLS AND INDICATORS
   A. SHEET 1: LOC, REM, AND SYS ALM ARE ON THE ALARM CONTROL UNITS (ACU'S)
   B. SHEET 2: LOCAL, REMOTE, PASS, AND TEST ARE ON THE SYNDES UNIT

3. UNIT REPLACEMENT AFTER REPLACING A UNIT, WAIT HALF A MINUTE TO SEE IF TROUBLE CLEARS BEFORE CONTINUING WITH TROUBLESHOOTING. ALSO CHECK STRAPPING ON THE UNIT

4. 91436 POWER DISTRIBUTION UNIT (PDU) REMOVE BOTH TALK BAT FUSES BEFORE PLUGGING UNIT INTO SHELF

NOTES ARE CONTINUED ON THE SECOND SHEET.

Figure 29. Troubleshooting Chart (Sheet 1 of 2).



NOTES (CONTINUED):

5 CHANNEL BANK LOOPBACK. IF THE SYS ALM LAMP IS NOT LIT, CREATE A SYSTEM ALARM BY OPENING OR SHORT-CIRCUITING THE DIGITAL RECEIVE LINE SIGNAL FOR A FEW SECONDS. IF THIS IS NOT CONVENIENT, OR IF THE CHANNEL BANK IS IN MODE 2, MOMENTARILY UNPLUG THE ACU, A OR B AS APPLICABLE. WITH THE SYS ALM LAMP LIT, THE CHANNEL BANK IS LOOPED BY THE FOLLOWING PROCEDURE:
A. DEPRESS AND RELEASE ACO BUTTON. WHITE ACO INDICATOR LIGHTS.
B. DEPRESS LOOP BUTTON. GREEN LOOP INDICATOR LIGHTS.
TO REMOVE BANK FROM LOOPED MODE, PROCEED AS FOLLOWS:
A. RELEASE LOOP BUTTON. LOOP INDICATOR GOES DARK.
B. IF TROUBLE IS CLEARED, SYS ALM LAMP GOES DARK AFTER A DELAY.
C. ACO INDICATOR GOES DARK WHEN SYSTEM ALARM CONDITION ENDS.

6 WHEN THE 91418 TREU IS INSTALLED, ALL TROUBLESHOOTING REFERENCES TO THE 91438 XMT UNIT AND 91439 RCV UNIT WILL APPLY TO THE TREU.

7 THIS TROUBLESHOOTING CHART IS PRIMARILY FOR THE 91430 SHELF. TO TROUBLESHOOT INDIVIDUAL CHANNEL UNIT PROBLEMS, REFER TO THE INDIVIDUAL CHANNEL UNIT PRACTICE.

Figure 29. Troubleshooting Chart (Sheet 2 of 2).

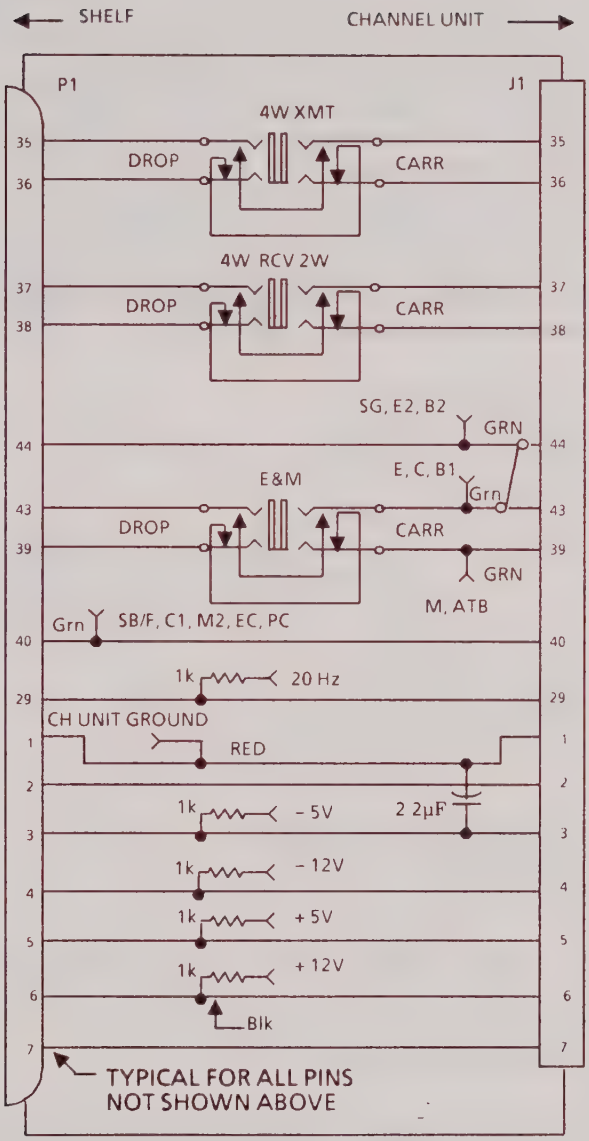


Figure 30. 91449 Channel Unit Extender Circuit Diagram.

7. PERFORMANCE MONITORING

7.01 The optional 91419 RPIU operates in the Standard Frame Format (SF) or the Extended Superframe Format (ESF). When used in the B8ZS/ESF format and in conjunction with the 91418 TREU, this unit monitors the performance of the DS1 spans, allows programming of the 91418 TREUs, and gathers alarm related information. When used in the SF format, this unit only provides a local alarm for each digroup. The digroup alarm data is transmitted to an alarm supervisory system. The 91419 RPIU periodically gathers data on the occurrence of Loss of Signal (LOS), Out of Frame (OOF) and Alarm Indication Signal (AIS), Cyclic Redundancy Check (CRC) block errors, and the number of Bipolar Violations (BPV) received. This information is used to calculate the following performance monitoring parameters:

- Line near Coding Violation (CV).
- Line near Errored Seconds (ES).
- Line near Severe Error Seconds (SES).
- Line near Bit Error Rate (BER).
- Line near Error-Free Seconds (EFS).
- Line far ES.
- Line far BER.
- Line far EFS.
- Path near CV.
- Path near Out Of Frame (OOF).
- Path near Framing Error (FE).
- Path near Severe Framing Error (SFE).
- Path near ES.
- Path near SES.
- Path near Unavailable Seconds (UAS).
- Path near Degraded Minute (DM).
- Path near BER.
- Path near EFS.
- Path far CV - mean value of Performance Report Message range information.
- Path far OOF.
- Path far FE - one per second maximum.
- Path far ES.
- Path far SES.
- Path far UAS - without LOS, because PRMs do not report LOS.
- Path far DM.
- Path far BER.
- Path far EFS.

7.02 All performance monitoring parameters are tracked on an hourly, daily, and cumulative total basis. Refer to Practice 342-911-133 for performance monitoring descriptive information, and to Practice 342-911-550 for the information on how to set up, program, and use this information. Practice 342-911-550 also provides definitions of the various performance monitoring terms listed above.

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9004B
PCM Channel Bank

9004B PCM Channel Bank
Assembly Wiring

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REVISIONS HISTORY

Issue	Date	Description	Approval
1	10-28-88	Original Issue	TT
1.1	12-07-89	Draft Issue to add ESF option	DRA

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TABLE A1

Assembly Power Wiring Connections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91455-01 Fuse and Alarm Panel	TB1 Rear of Shelf	3	-48V A Battery	Customer Battery Source	Customer Termination		Customer Specified	Note 1 Figure 2 Figure 2A
		4	-48V B Battery					
		1	Battery Ground					
		2	Rack Ground	Equipment Rack	Rack	N/A	163-109000-73	
	TB2 Rear of Shelf	1	-48V Battery	91430-XX Terminal Equipment Shelf #1	TB1 Shelf Backplane	3	103-11216-04	Note 4 Figure 2 Figure 2A Table B
		10	Battery Ground			1	103-11216-02	
		2	-48V Battery	91430-XX Terminal Equipment Shelf #2	TB1 Shelf Backplane	3	103-11216-04	
		11	Battery Ground			1	103-11216-02	
		3	-48V Battery	91430-XX Terminal Equipment Shelf #3	TB1 Shelf Backplane	3	103-11216-04	
		12	Battery Ground			1	103-11216-02	
		4	-48V Battery	91430-XX Terminal Equipment Shelf #4	TB1 Shelf Backplane	3	103-11216-04	
		13	Battery Ground			1	103-11216-02	
		5	-48V Battery	91430-XX Terminal Equipment Shelf #5	TB1 Shelf Backplane	3	103-11216-04	
		14	Battery Ground			1	103-11216-02	
		6	-48V Battery	91430-XX Terminal Equipment Shelf #6	TB1 Shelf Backplane	3	103-11216-04	
		14	Battery Ground			1	103-11216-02	
Customer Ringing Generator	Customer Termination		Ring Battery, 20Hz	91430-XX Terminal Equipment Shelf	TB1 Shelf Backplane	5	103-11222-04	Figure 1
			Ring Ground Return			6	103-11222-02	
			2600 Hz	91430-XX Terminal Equipment Shelf	TB1 Shelf Backplane	7	103-11222-04	Note 5
			2600 Hz Return (RTN)			8	103-11222-02	

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TABLE A2

Assembly DS1 Wiring Connections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91430-XX Terminal Equipment Shelf, 1 thru X	J66 Rear of Shelf	3	T - Digroup A Transmit	Customer DS1 Cross-Connect Equipment	Customer Termination		112-00153-05 Shielded Pair	Note 3 Note4 Figure 1 Table B
		4	R - Digroup A Transmit					
		1	Cable Shield					
		5	T - Digroup A Receive				112-00153-05 Shielded Pair	
		6	R - Digroup A Receive					
		1	Cable Shield					
	J76 Rear of Shelf	1	T - Digroup B Transmit				112-00153-05 Shielded Pair	
		2	R - Digroup B Transmit					
		3	Cable Shield					
		5	T - Digroup B Receive				112-00153-05 Shielded Pair	
		6	R - Digroup B Receive					
		3	Cable Shield					

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TABLE A3

Assembly VF/Signaling Wiring Connections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91430-01 Terminal Equipment Shelf, 1 thru X	J101 Rear of Shelf	Connector 1 thru 50	T1/R1 - Channels 1 thru 24 Digroup A	Customer DS0 Cross-Connect Equipment	Customer Termination		163-10315-XX or 163-10316-XX	Note 4 Figure 1 Table B1
	J102 Rear of Shelf	Connector 1 thru 50	T/R - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J103 Rear of Shelf	Connector 1 thru 50	E/SG - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J104 Rear of Shelf	Connector 1 thru 50	SB/M - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J201 Rear of Shelf	Connector 1 thru 50	T1/R1 - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	Note 4 Figure 1 Table B1
	J202 Rear of Shelf	Connector 1 thru 50	T/R - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
	J203 Rear of Shelf	Connector 1 thru 50	E/SG - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
	J204 Rear of Shelf	Connector 1 thru 50	SB/M - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
91430-11 Terminal Equipment Shelf, 1 thru X	J101 Rear of Shelf	Connector 1 thru 50	T1/R1 - Channels 1 thru 24 Digroup A	Customer DS0 Cross-Connect Equipment	Customer Termination		163-10315-XX or 163-10316-XX	Note 4 Figure 1 Table B1
	J102 Rear of Shelf	Connector 1 thru 50	T/R - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J103 Rear of Shelf	Connector 1 thru 50	E/SG - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J104 Rear of Shelf	Connector 1 thru 50	SB/M - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J105 Rear of Shelf	Connector 1 thru 50	BSY-1/SYN - Channels 1 thru 24 Digroup A				163-10315-XX or 163-10316-XX	
	J201 Rear of Shelf	Connector 1 thru 50	T1/R1 - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	Note 4 Figure 1 Table B1
	J202 Rear of Shelf	Connector 1 thru 50	T/R - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
	J203 Rear of Shelf	Connector 1 thru 50	E/SG - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
	J204 Rear of Shelf	Connector 1 thru 50	SB/M - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	
	J205 Rear of Shelf	Connector 1 thru 50	BSY-1/SYN - Channels 1 thru 24 Digroup B				163-10315-XX or 163-10316-XX	

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TABLE A4

Assembly Alarm and Clock Wiring Interconnections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #1 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		1A (Wht)	EAX Alarm - NO			13		
		1B (Blk)	EAX Alarm - Com			15		
		1C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #1 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		1D (Red)	EAX Alarm - NO			13		
		1E (Orn)	EAX Alarm - Com			15		
		1F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #1	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #2 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		2A (Wht)	EAX Alarm - NO			13		
		2B (Blk)	EAX Alarm - Com			15		
		2C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #2 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		2D (Red)	EAX Alarm - NO			13		
		2E (Orn)	EAX Alarm - Com			15		
		2F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #2	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		

(Continued on sheet 08)

TABLE A4

Assembly Alarm and Clock Wiring Interconnections - 91430-01, -11

FROM				TO				
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER	LEAD DESIGNATION	EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER	CABLE TYPE	FIGURE/ NOTE NO.
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #3 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		3A (Wht)	EAX Alarm - NO			13		
		3B (Blk)	EAX Alarm - Com			15		
		3C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #3 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		3D (Red)	EAX Alarm - NO			13		
		3E (Orn)	EAX Alarm - Com			15		
		3F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #3	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #4 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		4A (Wht)	EAX Alarm - NO			13		
		4B (Blk)	EAX Alarm - Com			15		
		4C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #4 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		4D (Red)	EAX Alarm - NO			13		
		4E (Orn)	EAX Alarm - Com			15		
		4F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #4	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		

(Continued on sheet 9)

TABLE A4

Assembly Alarm and Clock Wiring Interconnections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #5 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		5A (Wht)	EAX Alarm - NO			13		
		5B (Blk)	EAX Alarm - Com			15		
		5C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #5 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		5D (Red)	EAX Alarm - NO			13		
		5E (Orn)	EAX Alarm - Com			15		
		5F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #5	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #6 Digroup 2	J73 Shelf Backplane	1	Wiring Harness 088-91006-XX	Note 1 Note 2 Figure 2 Figure 2A Figure 3 Table B
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		6A (Wht)	EAX Alarm - NO			13		
		6B (Blk)	EAX Alarm - Com			15		
		6C (Brn)	EAX Alarm - NC			17		
		9D (Vio)	Audible Alarm - NO	91430-XX Terminal Shelf #6 Digroup 1	J63 Shelf Backplane	1		
		9E (Blu)	Audible Alarm - Com			3		
		7D (Slt)	Visual Alarm - NO			7		
		7E (Blk-Wht)	Visual Alarm - Com			9		
		6D (Red)	EAX Alarm - NO			13		
		6E (Orn)	EAX Alarm - Com			15		
		6F (Yel)	EAX Alarm - NC			17		
		8A (Wht-Orn)	Composite Clock - T	91430-XX Terminal Shelf #6	J62 Shelf Backplane	38		
		9A (Grn-Wht)	Composite Clock - R			42		

(Continued on sheet 10)

TABLE A4

Assembly Alarm and Clock Wiring Interconnections - 91430-01, -11

FROM			LEAD DESIGNATION	TO			CABLE TYPE	FIGURE/ NOTE NO.
EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		EQUIPMENT DESCRIPTION	POSTION	PIN NUMBER		
91455-01 Fuse and Alarm Panel	TB3 Rear of Shelf	7A	Office System Audible Alarm - NO	Customer's Office Equipment	Customer Termination		Customer Specified Cable	Figure 2 Figure 2A Figure 3 Table B
		7B	Office System Audible Alarm - Com					
		7C	Office System Audible Alarm - NC					
		7D	Visual Alarm - NO					
		7E	Visual Alarm - Com					
		8A	Composite Clock - T					
		8E	Ground Switch					
		8F	Ground Switch					
		9A	Composite Clock - R					
		10A	Office Fuse Alarm Output 1 - NO					
		10B	Office Fuse Alarm Output 1 - Com					
		10C	Office Fuse Alarm Output 1 - NC					
		10D	Office Fuse Alarm Output 2 - NO					
		10E	Office Fuse Alarm Output 2 - Com					
		10F	Office Fuse Alarm Output 2 - NC					
91430-XX Terminal Equipment Shelf W/CMS	J62 Rear of Shelf	17	Transmit Data	905-24421-01 CRT Maintenance Shelf	J1 Rear of Shelf	F	Customer Specified Cable	
		18	Receive Data			D		
		19	Signal Ground			B		
		24	Data Terminal Ready			Z		
91430-XX Terminal Equipment Shelf W/Modem		17	Transmit Data	163-56701-01 Hayes 1200 Smartmodem	RS-232C Connector Rear of Modem	3		
		18	Receive Data			2		
		19	Signal Ground			7		
		20	Request to Send			5		
		21	Clear to Send			4		
		22	Data Set Ready			20		
		23	Data Carrier Detect			8		
		24	Data Terminal Ready			6		
91430-XX Terminal Equipment Shelf W/CRT		17	Transmit Data	163-56700-01 Wyse 50 Terminal	RS-232C Connector Rear of Terminal	3		
		18	Receive Data			2		
		19	Signal Ground			7		
		24	Data Terminal Ready			6		

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TABLE A5

Assembly Wiring Notes - 91430-01, -11

Notes:

1. Optional Strapping of 91455 Fuse and Alarm Panel.

   If separate battery feeds are required for a -48V "A" and -48V "B" power supplies, remove strap between terminals 3&4 of TB1. If separate frame and battery grounds are required, remove the strap between terminals 1&2 of TB1.

2. Wiring Harness 088-91006-XX

   This wiring harness consists of 24 AWG solid wires to be wire wrapped at TB3 of the Fuse and Alarm Panel. The other ends, which terminate at J63, J73, and J62 on the Terminal Equipment Shelf, are connectorized.

3 High Speed Cable Lengths

   Maximum cable length for DS1 signals is 200m (655 ft).
   Maximum cable length for DS1C signals is 122m (400 ft).

4. Optional Installation Kit for FCC Part 15 compliance

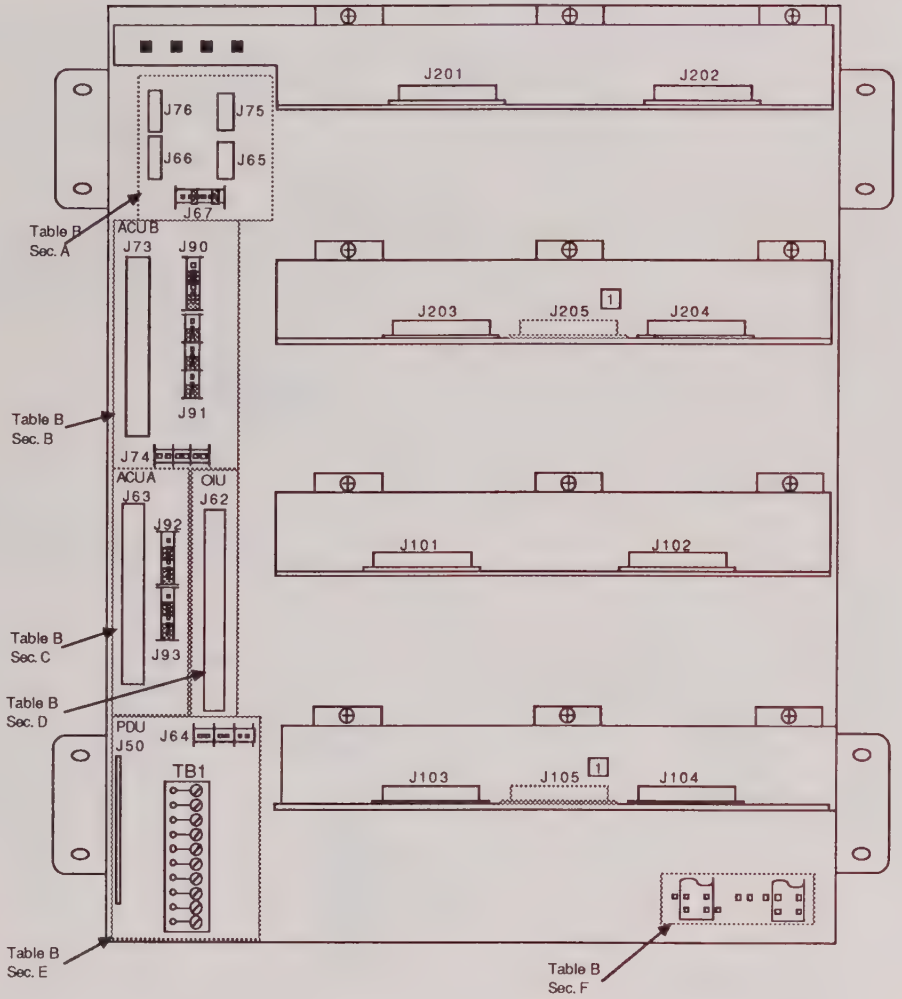
   If Installation Kit 970-91430-01 is chosen to insure compliance with FCC regulations part 15, the T1 leads, the VF cables, and the battery and ground leads must be wrapped through ferrite cores provided in the installation kit. Please follow the complete instructions furnished in the kit.

5. For 2600Hz Operation

   This connection is required for operation of the 91434-01 Channel Units when 2600Hz ring is required.

FIGURE 1

9004B Shelf Backplane Component Layout



Plug Assignments

J101	T1,R1	DIGROUP A
J102	T,R	
J103	E,SG	
J104	SB,M	
J105	BSY-1,SYN	
J201	T1,R1	DIGROUP B
J202	T,R	
J203	E,SG	
J204	SB,M	
J205	BSY-1,SYN	

[1] J105 and J205 are provided only with 91430-11 Shelf Options.

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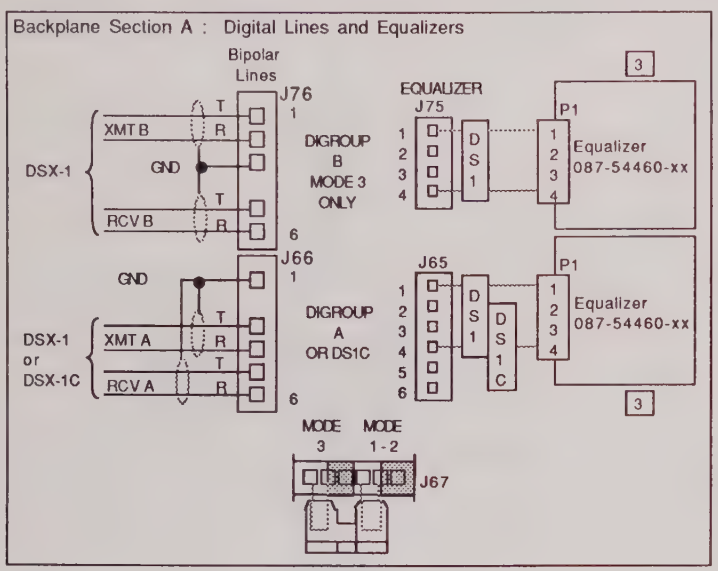
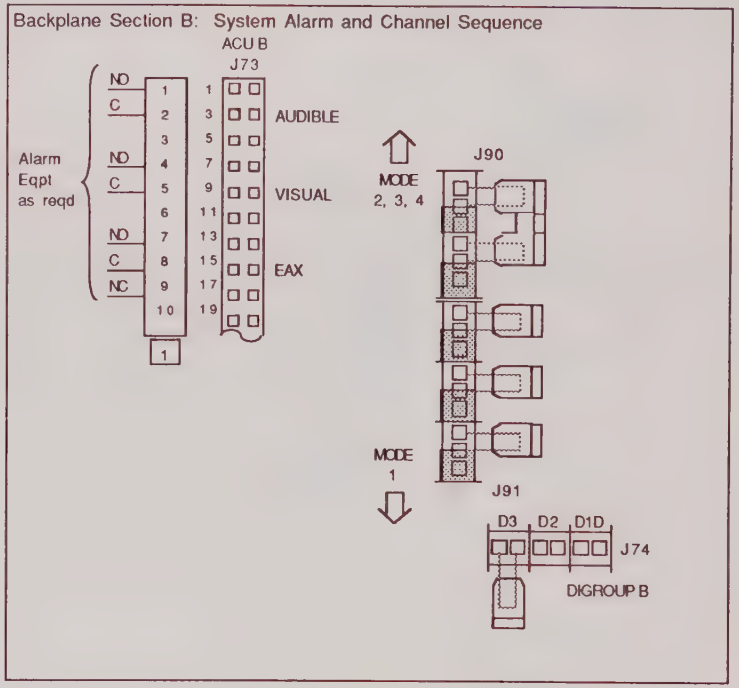
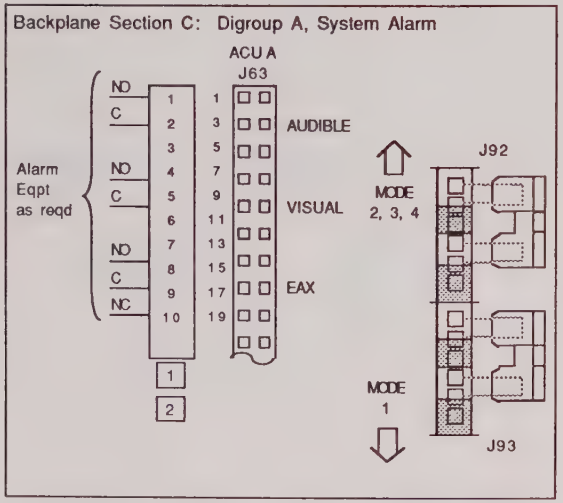
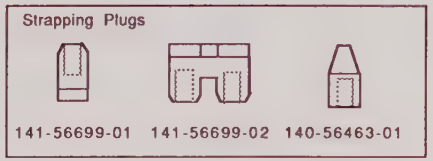
TABLE B

9004B Backplane Connections and Strapping Options









NOTES:

1. System Alarm and Composite Clock.
   Connectors that plug onto the wirewrap terminals of J62, J63, and J73 are part of wiring harness 088-91006-xx.
2. Supervisory System
   Connectors that plug onto the wirewrap terminals of J62 are part of a locally fabricated wiring harness.
3. TREU by-Pass
   When using with TREU use Equalizer by-pass 087-99004-01.

(Continued on sheet 14)

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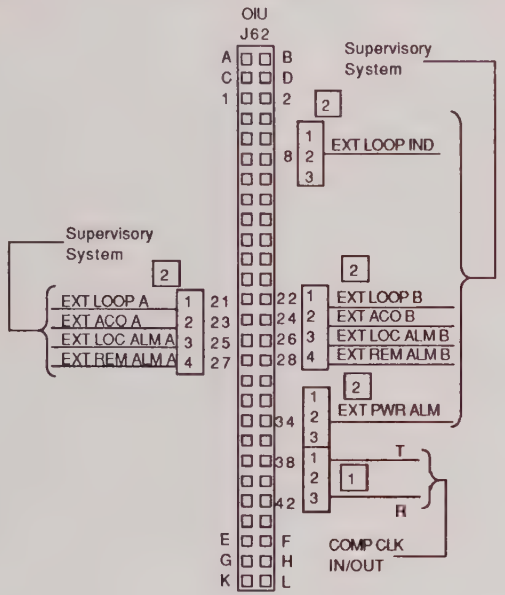
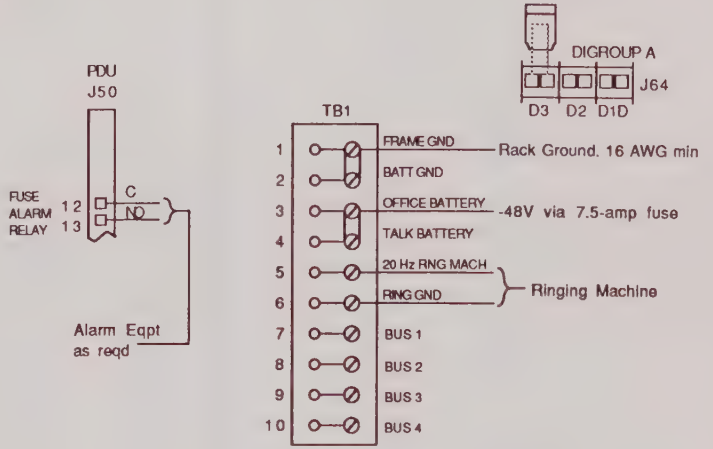
TABLE B

9004B Backplane Connections and Strapping Options

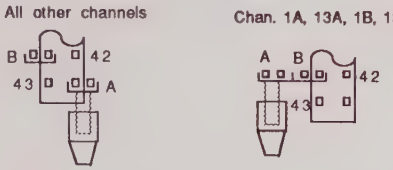
Backplane Section D: Supervisory System and Composite Clock



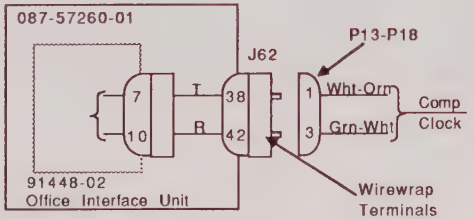
Backplane Section E: Power Input, Fuse Alarm, and Digroup A Channel Sequence



Backplane Section F: TMB Strapping



Composite Clock Input/Output at OIUs



NOTES:

[1] System Alarm and Composite Clock.
Connectors that plug onto the wirewrap terminals of J62, J63, and J73 are part of wiring harness 088-91006-xx.

[2] Supervisory System.
Connectors that plug onto the wirewrap terminals of J62 are part of a locally fabricated wiring harness.

(Continued on sheet 15)

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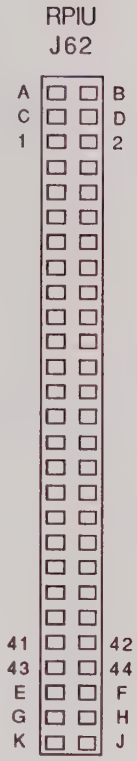
TABLE B

9004B Backplane Connections and Strapping Options



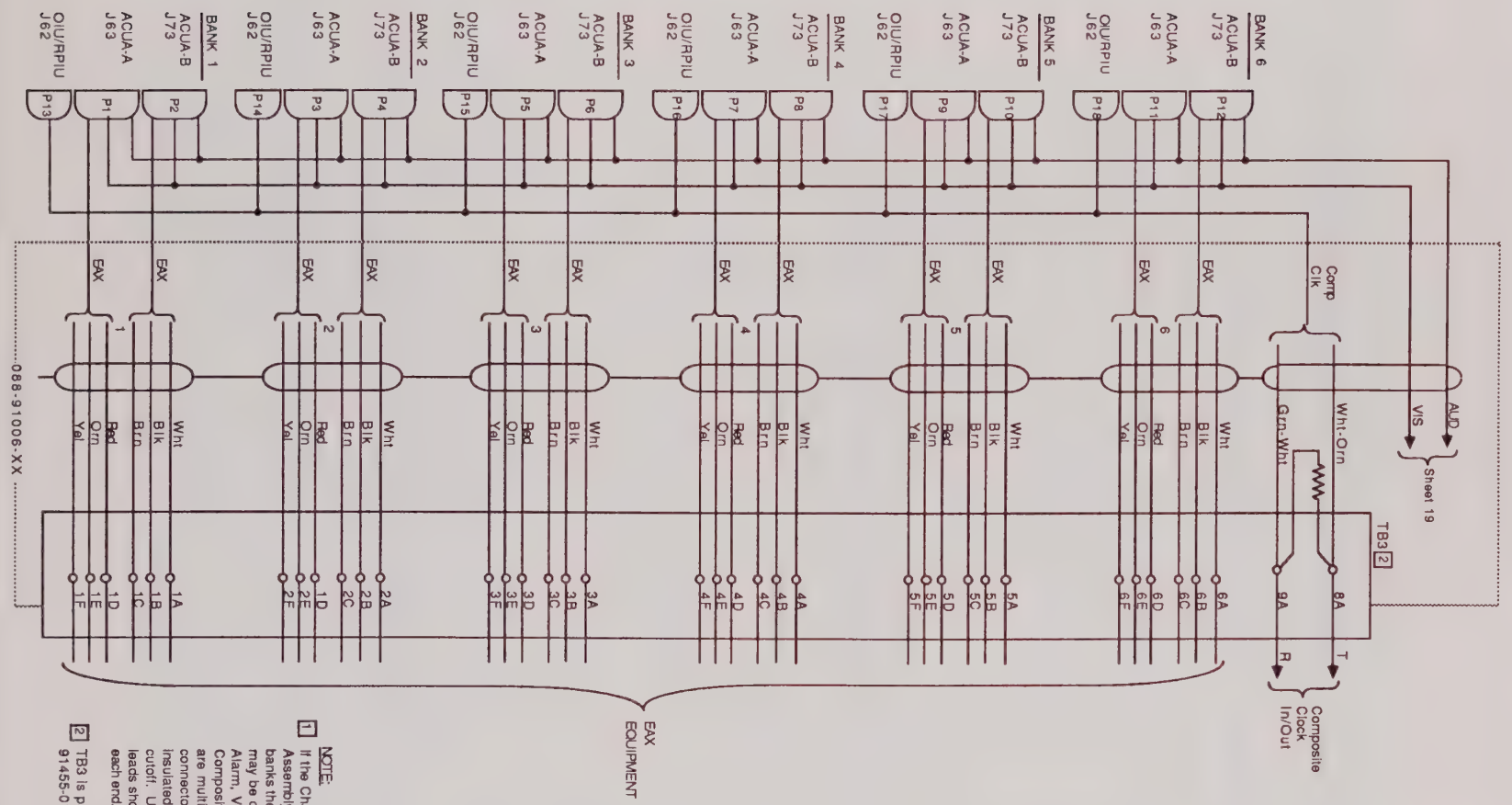
Backplane Section D: 91419 RPIU Backplane Pinouts.

PINOUT	DIRECTION	FUNCTION	PINOUT	DIRECTION	FUNCTION
A	NONE	NONE	24	OUTPUT	DTR 232
B	NONE	NONE	25	OUTPUT	TXD 422A
C	NONE	NONE	26	OUTPUT	TXD 422B
D	NONE	NONE	27	INPUT	RXD 422A
1	OUTPUT	EXT LOOP $\overline{B}$	28	INPUT	RXD 422B
2	INOUT	-AC5 B	29	INPUT	GND
3	INPUT	-AY $\overline{B}$	30	INPUT	GND
4	OUTPUT	EXT CLK	31	INPUT	+5 VOLTS
5	INPUT	-AR $\overline{B}$	32	OUTPUT	DEGPC
6	INPUT	CH PR-24A	33	INPUT	-AC5 $\overline{A}$
7	OUTPUT	ACO2 $\overline{B}$	34	OUTPUT	DEGPNO
8	OUTPUT	DEGPNC	35	OUTPUT	EXTLP $\overline{A}$
9	OUTPUT	ACO1 $\overline{B}$	36	OUTPUT	NONE
10	INPUT	PWR ALM	37	INPUT	-AY $\overline{A}$
11	NONE	NONE	38	I/O	T COMPOSIT CLK
12	NONE	NONE	39	INPUT	-AR $\overline{A}$
13	OUTPUT	BIT SYNC	40	INPUT	-12 VOLTS
14	INPUT	CH PR-24B	41	OUTPUT	ACO2 $\overline{A}$
15	OUTPUT	BYTE SYNC	42	I/O	R COMPOSIT CLK
16	INPUT	NONE	43	OUTPUT	ACO1 $\overline{A}$
17	OUTPUT	TXD 232	44	NONE	NONE
18	INPUT	RXD 232	E	NONE	NONE
19	OUTPUT	SGND 232	F	NONE	NONE
20	INPUT	RTS 232	G	NONE	NONE
21	OUTPUT	CTS 232	H	NONE	NONE
22	INPUT	DSR 232	K	OUTPUT	SGND 422
23	INPUT	DCD 232	J	NONE	NONE

(Continued on Sheet 16)

TABLE B

9004B Backplane Connection and Strapping Options



NOTE:

1 If the Channel Bank Assembly has fewer than six banks the excess harness may be cut off. Audible Alarm, Visual Alarm and Composite Clock leads, which are multiplied between connectors, should be insulated and tied back at the cutoff. Unused EAX alarm leads should be tied back at each end.

2 TB3 is part of the 91455-01 Fuse Panel.

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Table B1

163-10315-XX / 163-10316-XX Cable Assembly Pinout Translation

			DIGROUP 1					DIGROUP 2				
Conn. Pin #	Color Code	Channel Assigment	Conn. J101	Conn. J102	Conn. J103	Conn. J104	Conn. J105	Conn. J201	Conn. J202	Conn. J203	Conn. J204	Conn. J205
1	Blu/Wht	Channel 1	R1	R	SG	M	SYN	R1	R	SG	M	SYN
26	Wht/Blu	Channel 1	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
2	Orn/Wht	Channel 2	R1	R	SG	M	SYN	R1	R	SG	M	SYN
27	Wht/Orn	Channel 2	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
3	Grn/Wht	Channel 3	R1	R	SG	M	SYN	R1	R	SG	M	SYN
28	Wht/Grn	Channel 3	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
4	Brn/Wht	Channel 4	R1	R	SG	M	SYN	R1	R	SG	M	SYN
29	Wht/Brn	Channel 4	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
5	Slt/Wht	Channel 5	R1	R	SG	M	SYN	R1	R	SG	M	SYN
30	Wht/Slt	Channel 5	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
6	Blu/Red	Channel 6	R1	R	SG	M	SYN	R1	R	SG	M	SYN
31	Red/Blu	Channel 6	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
7	Orn/Red	Channel 7	R1	R	SG	M	SYN	R1	R	SG	M	SYN
32	Red/Orn	Channel 7	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
8	Grn/Red	Channel 8	R1	R	SG	M	SYN	R1	R	SG	M	SYN
33	Red/Grn	Channel 8	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
9	Brn/Red	Channel 9	R1	R	SG	M	SYN	R1	R	SG	M	SYN
34	Red/Brn	Channel 9	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
10	Slt/Red	Channel 10	R1	R	SG	M	SYN	R1	R	SG	M	SYN
35	Red/Slt	Channel 10	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
11	Blu/Yel	Channel 11	R1	R	SG	M	SYN	R1	R	SG	M	SYN
36	Yel/Blu	Channel 11	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
12	Orn/Yel	Channel 12	R1	R	SG	M	SYN	R1	R	SG	M	SYN
37	Yel/Orn	Channel 12	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
13	Grn/Yel	Channel 13	R1	R	SG	M	SYN	R1	R	SG	M	SYN
38	Yel/Grn	Channel 13	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
14	Brn/Yel	Channel 14	R1	R	SG	M	SYN	R1	R	SG	M	SYN
39	Yel/Brn	Channel 14	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
15	Slt/Yel	Channel 15	R1	R	SG	M	SYN	R1	R	SG	M	SYN
40	Yel/Slt	Channel 15	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
16	Blu/Blk	Channel 16	R1	R	SG	M	SYN	R1	R	SG	M	SYN
41	Blk/Blu	Channel 16	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
17	Orn/Blk	Channel 17	R1	R	SG	M	SYN	R1	R	SG	M	SYN
42	Blk/Orn	Channel 17	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
18	Grn/Blk	Channel 18	R1	R	SG	M	SYN	R1	R	SG	M	SYN
43	Blk/Grn	Channel 18	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
19	Brn/Blk	Channel 19	R1	R	SG	M	SYN	R1	R	SG	M	SYN
44	Blk/Brn	Channel 19	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
20	Slt/Blk	Channel 20	R1	R	SG	M	SYN	R1	R	SG	M	SYN
45	Blk/Slt	Channel 20	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
21	Blu/Vio	Channel 21	R1	R	SG	M	SYN	R1	R	SG	M	SYN
46	Vio/Blu	Channel 21	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
22	Orn/Vio	Channel 22	R1	R	SG	M	SYN	R1	R	SG	M	SYN
47	Vio/Orn	Channel 22	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
23	Grn/Vio	Channel 23	R1	R	SG	M	SYN	R1	R	SG	M	SYN
48	Vio/Grn	Channel 23	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
24	Brn/Vio	Channel 24	R1	R	SG	M	SYN	R1	R	SG	M	SYN
49	Vio/Brn	Channel 24	T1	T	E	SB	BSY-1	T1	T	E	SB	BSY-1
25	Slt/Vio	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
50	Vio/Slt	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

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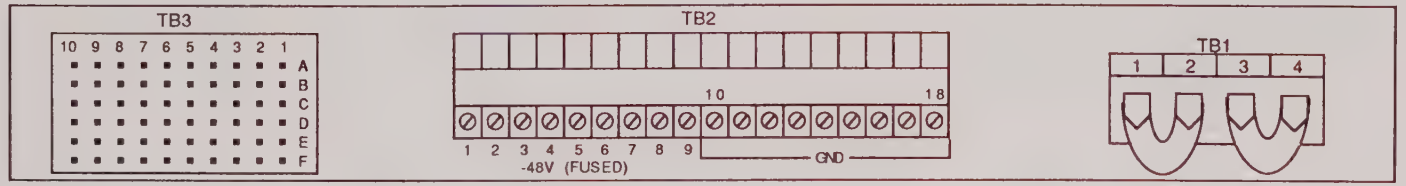
FIGURE 2

91455 -01 Fuse and Alarm Panel Backplane



Fuses.

GMT alarm-type fuses F1 through F9 are not furnished with the 91455-01 panel and must be ordered seperately. The standard size for the 9004B Channel Bank (F1 through F6) is 7-1/2 amp. The maximum size for F9 is 1 amp. This limit is imposed by the range of diodes that isolate A and B supplies.

Fuse Rating Amperes	Color	Siemens Stock No. 175-28996
0.18	Yellow	-04
1/4	Violet	-05
1/2	Red	-09
3/4	Brown	-06
1	Gray	-01
1-13	White	-02
2	Orange	-03
3	Blue	-07
5	Green	-10
7-1/2	Black-White	-12

Fuse Cover.

Fuses should be equipped with a plastic fuse cover, part number 122-71501-01, as shown below.

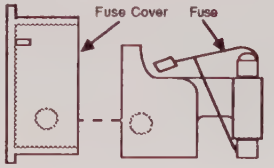


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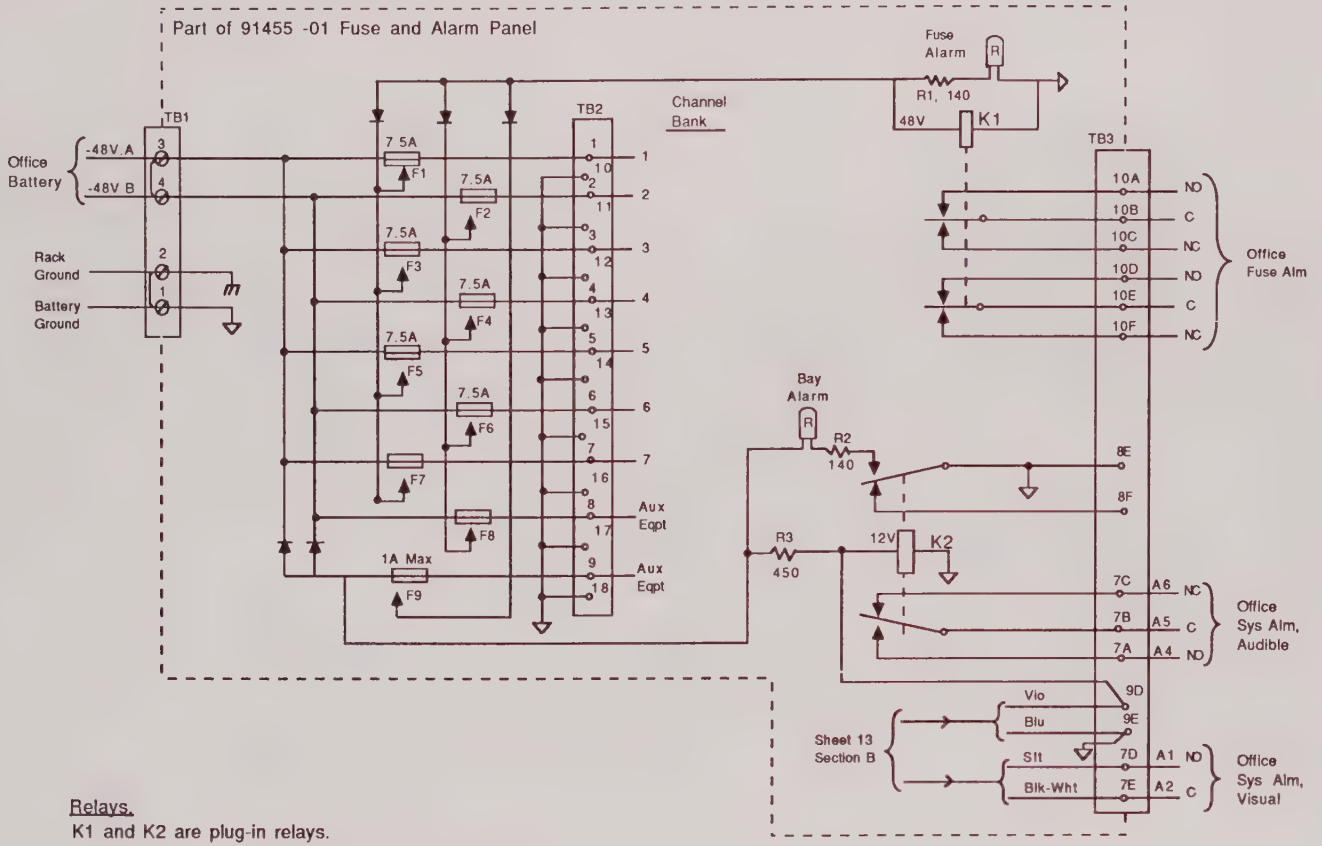
FIGURE 2A

91455-01 Fuse and Alarm Panel Circuit Diagram



Relays.
K1 and K2 are plug-in relays.
They are shown in the condition of normal operation.

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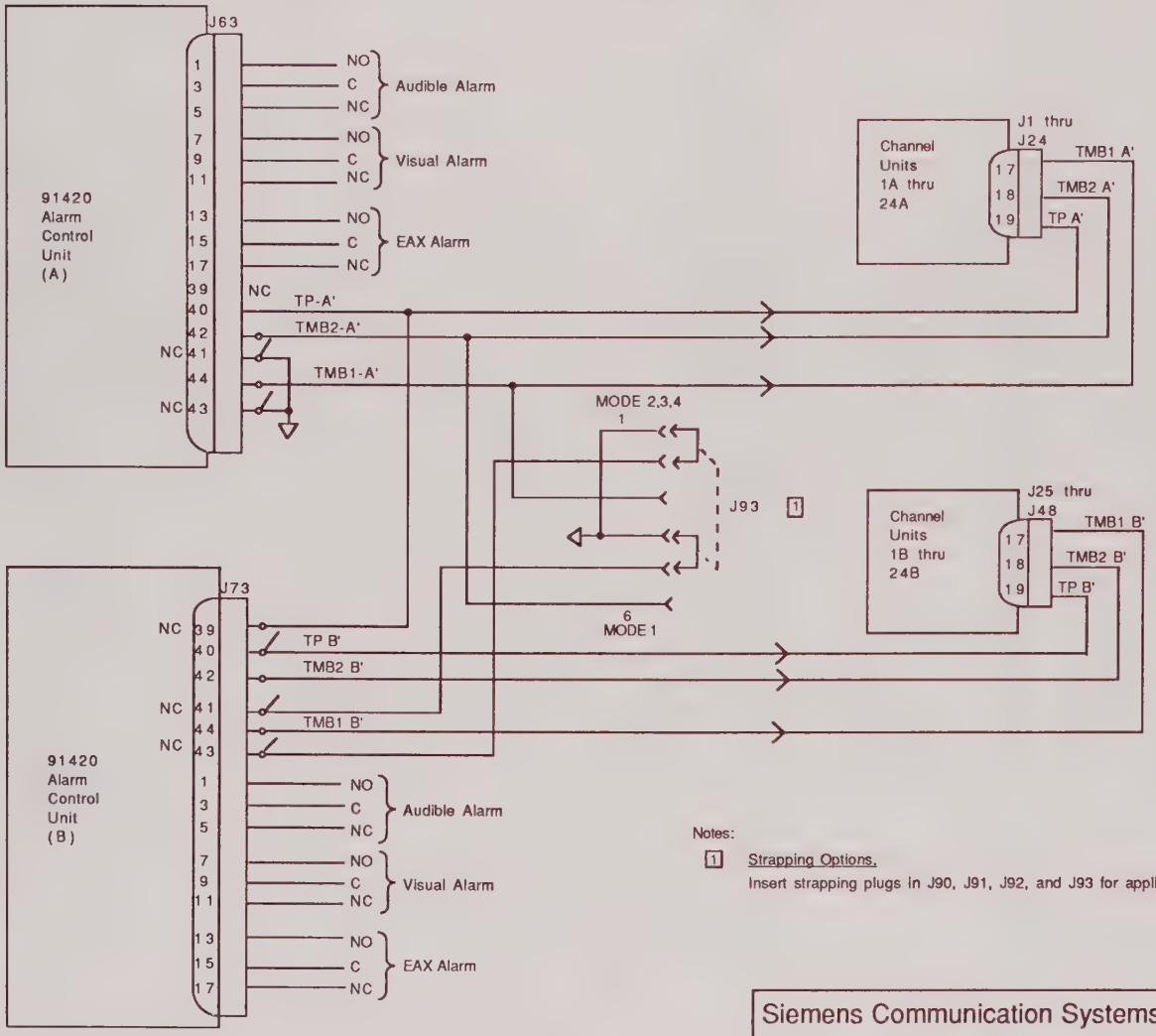
FIGURE 3

Alarm Control Unit - External Connections



Notes:

1 Strapping Options.
Insert strapping plugs in J90, J91, J92, and J93 for applicable mode.

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Section 342-911-550
Issue 1, September 1990

9004B

9004B ESF PCM Channel Bank
User's Guide

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EIA Symbol

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1. INTRODUCTION

1.01 The Remote Performance Interface Unit (RPIU) is an optional card of the 9004B system which is used to provide extensive Performance Monitoring of the 9004B DS1 spans, gather 9004 alarm-related information, and provide a Digital Data Service (DDS) clock interface to the 9004B terminal.

NOTE: Implementation of the features described in this Practice requires that the RPIU be installed according to the procedures described in Practice 342-911-134.

Types of Commands

1.02 This section describes the 9004B ESF RPIU input commands, which are divided into MONITOR commands and ADMINISTRATIVE commands.

(a) MONITOR commands let the user access information, and enable or disable certain features without disrupting traffic. These commands are available when the user accesses the RPIU. The MONITOR commands are also available in the ADMINISTRATIVE mode.

(b) ADMINISTRATIVE commands let the user use features that can disrupt traffic. These commands are accessed from the ADMINISTRATIVE mode. The user may limit access by requiring a password.

1.03 MONITOR and ADMINISTRATIVE commands provide all system interaction via a RS-232 port. To initiate this interaction, the user must type in a single command and wait for the system response. Online help is available for any command via the HELP command.

Input Device

1.04 The RPIU provides an RS-232 port (1200 baud, 8 data bits, 1 stop bit, and no parity) for an optional connection to a CRT terminal.

1.05 To input information, the user can use a CRT terminal that is either physically connected to the RPIU (local access) or remotely connected to the RPIU via a modem (remote access). Optionally, the RS-232 port can be connected to a CRT Maintenance Shelf as described in Practice 342-930-100 to provide local and remote access.

Sign-On Message

1.06 After the CRT terminal is connected, press the RETURN key. A STATUS report will be displayed followed by a command prompt. This prompt signifies that the system is ready to accept a command. The default prompt is 9004B, and becomes the first 5 characters of the node name after the ADMINISTRATIVE NAME command has been issued to assign a node name.

Synchronous and Asynchronous Display

1.07 When the user submits commands, the CRT displays command responses called synchronous, or solicited output. The CRT may also display messages whenever reportable events occur in the system. These messages are called asynchronous, or unsolicited output. All alarm events detected by the RPIU, for example, produce asynchronous messages to the CRT port. The user can monitor this port directly via the CRT, or by connecting a printer in parallel with the CRT to obtain a complete hardcopy listing of all alarm conditions.

Command Error Messages

1.08 The user receives an error message whenever a command is entered which the system does not recognize. Typical error messages include UNKNOWN COMMAND and ILLEGAL KEYWORD.

Command Abbreviation

1.09 The user can enter commands by typing either the full command name or an abbreviated form of the command name, and pressing RETURN. An abbreviation is any sequence of letters of the command name (including the first letter) that uniquely indicates the command. The system displays an error message if there is any ambiguity. The minimal abbreviation for each command is:

MONITOR Command	Abbreviation
ACO	A
CLEAR	CL
CONFIGURATION	C
DATE	D
EXCEPTIONS	EX
HELP	H
HISTORY	HI
MODE	M
NAME	N
OUTPUT	O
PERFORMANCE	P
PERIODIC	PI
STATUS	S
TIME	TI
TROUBLE	TR

ADMINISTRATIVE Command	Abbreviation
CONFIGURATION	C
DATE	D
ERASE	ERASE
HISTORY	HI
LOOPBACK	LO
NAME	N
PASSWORD	PW
PERFORMANCE	P
RESET	RES
THRESHOLD	THR
TIME	T

Command Stack

1.10 The user can retrieve up to 50 previously entered commands by using the UP and DOWN arrow keys. To edit one of these commands, use the LEFT and RIGHT arrow keys and/or the BACKSPACE key. Reenter the edited command by pressing the RETURN key. This feature is useful when working with long command strings, which occur with the PERFORMANCE command.

Command Syntax

1.11 Both sets of brackets, { } and [ ], indicate optional values. The presence of a default value is specified by { }. If no default value is present, it is specified by [ ]. Field information must, therefore, be provided.

NOTE: On commands where the default values are available, an omission of the field will activate the default.

2. MONITOR MODE COMMANDS

2.01 The MONITOR mode commands are view only; the user cannot initiate traffic affecting changes to the system by using them. The MONITOR mode is the standard operating mode when a user connects to the system. All MONITOR commands are available in the ADMINISTRATIVE mode. The MONITOR mode commands are:

ACO
CLEAR
CONFIGURATION (display only)
DATE (display only)
EXCEPTIONS
HELP
HISTORY (display only)
MODE
NAME
OUTPUT (used only in conjunction with HELP, for example, HELP OUTPUT)
PERFORMANCE
PERIODIC
STATUS
TIME (display only)
TROUBLE

ACO (A)

Command: ACO DSI – *n*
where *n* = [A / B]

The Audible Alarm Cut-Off (ACO) command turns off the audible system alarm bell. The alarm can be turned off at the Alarm Control Unit (ACU) by pressing the ACO button. The ACO command can only be activated if the digroup is experiencing a SYSTEM ALARM.

To turn off the alarm bell for digroup A, for example, the user enters ACO DS1 – A. The ACO light on the ACU remains on as a reminder that an alarm condition exists. ACO will be terminated when the alarm condition is eliminated or the next alarm condition occurs.

CLEAR (CL)

Command: CLEAR

The CLEAR command clears the CRT screen and sends a page eject to a connected and enabled printer. This command is useful to quickly determine whether any asynchronous messages have occurred since the last CLEAR.

CONFIGURATION (C)

Command: CONFIGURATION { RPIU / DSI – A / DSI – B } Default = all

The CONFIGURATION command displays the system's current reset configuration.

RPIU configuration information includes product identification (9004B ESF), name (see NAME command), mode (ADMINISTRATIVE or MONITOR), TPR (for example, Siemens Communication Systems, Inc. Product Release 4.1.1.1), release Date, and STS EPROM Part Number.

Transmit/Receive ESF Unit (TREU) configuration information includes Name (DSI – A or DSI – B), Degraded Performance (DP) elements that are enabled (if no elements are enabled a "none enabled" message is received), software override status (ON or OFF), line coding option (B8ZS ON or OFF), transmit clock option (Internal, External, or Looped), Line Build-Out option (0 to 110 feet, 110 to 220 feet,...,550 to 660 feet), Mode (3), channel sequencing (D3), format (Superframe or Extended Superframe), B7 Signaling (ON or OFF), and Test Tone (ON or OFF).

Example Screen:

```
9004B: Configuration

Product: Siemens 9004B

TPR: 0.0.0.0
EPROM: 179-56493-21
Date: 08/11/89
Name: PHx01 – 32ND ST AND MAIN
Mode: ADMIN
DP Mask:
  – None Enabled

Digroup: DS1 – A
  – Software Override OFF
  – B8ZS line coding ON
  – Looped xmt clock
  – 0 to 110 feet of LBO
  – Mode 3
  – D3 Sequencing
  – DS1 Extended Superframe format
  – B7 Signaling ON
  – Tone OFF

DS1 – B is Not Present
```

DATE (D)

Command: DATE

The DATE command provides the current running date and time of the system. The date is set using the ADMINISTRATIVE DATE command.

To view the current date, enter DATE.

EXCEPTIONS (EX)

Command: EXCEPTIONS

The EXCEPTIONS command locates and displays all current exceptions or abnormalities in the system.

Example Screen:

9004B: Exceptions
DS1 – A: Degraded Performance LED
DS1 – B: Card not present
DS1 – A: LINE NEAR HOURLY CV Past Threshold
DS1 – A: LINE FAR HOURLY CV Past Threshold
DS1 – A: PATH NEAR HOURLY UAS Past Threshold
DS1 – A: PATH NEAR DAILY UAS Past Threshold
DS1 – A: PATH NEAR TOTAL UAS Past Threshold
DS1 – A: LINE NEAR HOURLY BER Past Threshold
DS1 – A: LINE NEAR HOURLY EFS Past Threshold
DS1 – A: LINE NEAR TOTAL BER Past Threshold
DS1 – A: LINE NEAR TOTAL EFS Past Threshold
DS1 – A: PATH NEAR HOURLY EFS Past Threshold
DS1 – A: PATH NEAR TOTAL EFS Past Threshold

HELP (H)

The HELP commands let the user access the online help that is available for each command described in this section of the Practice. If no command name is provided, or an invalid command name is entered, the available commands are listed. If a valid command name is entered, the help screen for that command is displayed. The help screens are for reference only. For more information about a specific command, the user should refer to the command listing in this Practice.

```
9004B: Help Configuration

CONFIGURATION (C): Display configuration information.

USAGE:
CONFIG { RPIU | DS1 – A | DS1 – B | ALL } (ALL)
CONFIG RPIU DP [ LINE | PATH | NEAR | . . . | DM ] [ ON | OFF ]
CONFIG DS1 – n OVERRIDE { ON | OFF }
CONFIG DS1 – n B8ZS { ON | OFF }
CONFIG DS1 – n CLOCK { INT | EXT | LOOP }
```

```
9004B: Help Loopback

LOOPBACK: Use the various loopback options.

USAGE:
LOOPBACK layer location DS1 – n { CANCEL }
WHERE:
layer = { LINE | PATH }
location = { LOCAL | NEAR | FAR }
n = { A | B }
```

HISTORY (HI)

Commands: HISTORY {SOFTWARE}

The HISTORY command displays the alarm history. This history contains a record of the events that caused or cleared an alarm condition. Up to 47 alarm events are recorded. After 47 alarm events have been recorded, new alarm events overwrite older alarm events. HISTORY displays alarm events in a Last-In-First-Out (LIFO) format. A time stamp is embedded into each message which tracks the exact time and date of the original occurrence.

The HISTORY {SOFTWARE} command displays a table showing software history which contains a record of software events, such as internal software checks, Non-Maskable Interrupt faults (NMI), and system reset messages. A maximum of 2 events can be recorded.

NOTE: Messages are recorded using FIFO and displayed using LIFO. History information is stored in nonvolatile memory.

```
9004B: History

47 logged event(s) . . .
01:  09:00:50  11/17/89   DS1 – A: System Alarm CLEAR
02:  09:00:35  11/17/89   DS1 – A: LINE LOCAL Loopback deactivated
```

```
9004B: History Software

2 logged event(s) . . .
01:  09:06:29  11/17/89   RPIU Up
02:  09:06:20  11/17/89   RPIU Reset 0
```

MODE (M)

Commands: MODE MONITOR
MODE ADMIN

The MODE command selects either the MONITOR mode or the ADMINISTRATIVE mode. MONITOR commands do not affect traffic and never require a password. ADMINISTRATIVE commands may affect traffic and may require a password. A password prompt appears when a password is required. Passwords are changed with the ADMINISTRATIVE PASSWORD command. The MONITOR mode is the system default, and all MONITOR mode commands are available in the ADMINISTRATIVE mode.

User Entry: To transfer to the ADMINISTRATIVE mode from the MONITOR mode, enter MODE ADMIN, and then the password if required.

User Entry: To transfer to the MONITOR mode from the ADMINISTRATIVE mode, enter MODE MONITOR.

NOTE: If the user is in the ADMINISTRATIVE mode and no CRT terminal input is received for a period of 15 minutes, the system, as a precaution, automatically returns to the MONITOR mode.

NAME (N)

Command: NAME

The NAME command displays the name of the node. At system installation, the node name does not exist and the default prompt (9004B:) appears. The node name is displayed each time either the CONFIGURATION RPIU or the NAME command is entered. The name can be a string of up to 26 characters. If there are spaces within the string, the name must appear in quotes. The user can rename a node only while in the ADMINISTRATIVE mode.

User Entry: To display the name of the node, enter NAME.

OUTPUT (O)

Command: OUTPUT

The OUTPUT command entered by itself is not recognized by the system; it is a special command used only in conjunction with the HELP command. For example, HELP OUTPUT displays user output control options. These control options include:

(a) Holding down both the CNTL and S keys halts output for up to 60 seconds.

(b) Holding down both the CNTL and Q keys restarts output that is halted using the CNTL and S keys.

(c) Holding down both the CNTL and X keys stops the current command. The latest command string, including all subsequent output, is ignored.

(d) Holding down both the CNTL and D keys disconnects the software from the CRT. This is the only output control command that affects asynchronous commands. Press the ENTER key twice to reconnect.

PERFORMANCE (P)

Commands: PERFORMANCE {ENTRY *n*} {LAYER} {END} {INTERVAL} {PARAMETER} {PORT} {MONITOR COUNT}

User Entry: The user may enter any, all, or none of the options listed on the command line, though the options must be listed in the order shown above.

The PERFORMANCE command displays system performance information. The keywords for the various fields on the command line are:

ENTRY: If the keyword ENTRY is specified, it must be followed immediately by a number. This number is interpreted by the system as an entry number. The RPIU provides 24 HOURLY entries numbered from 1 to 24, 7 DAILY entries numbered from 1 to 7, and 1 (one) TOTAL entry numbered 1 for each and every parameter. The Bit Error Rate (BER) parameters also have an ENTRY 0 parameter. If ENTRY and the entry number are not specified on the command line, only entry 1 is displayed. (Entry number 1 is the default.) The user can display all available entries by specifying the keyword ALL in this field.

NOTE: For BER only, ENTRY number 0 (zero) is defined. ENTRY number 0 uses the actual time elapsed, while ENTRY number 1 (one) assumes the entire period in the calculation of BER. Threshold crossings are based on ENTRY 1 information for all parameters.

LAYER: The LAYER option specifies whether LINE or PATH parameters are displayed. LINE performance is based on BPVs, while PATH performance is based on CRC – 6 errors. If the user does not specify a layer, both LINE and PATH information appears.

END: The END option specifies whether the Performance Monitoring (PM) parameters apply to the NEAR or the FAR end. Near end parameters provide performance measures on received data, while far end parameters measure performance on transmitted data. The transmit data is collected via Performance Report Messages received each second. If no END is specified both near and far end PM information appears.

INTERVAL: The INTERVAL option specifies the time interval of the Performance Monitoring data to be displayed. The available intervals are HOURLY, DAILY, and TOTAL. When working with BER parameters, an additional interval, CURRENT, is available because HOURLY, DAILY, and TOTAL values may not represent the error rate currently being experienced. If no interval is specified, information over all intervals is displayed.

PERFORMANCE (Continued)

PARAMETER or PARM: The PARAMETER option specifies which, if any, PM parameters are displayed. The available error parameters are Coding Violation (CV), Out Of Frame Second (OOF), Framing Error (FE), Severe Framing Error (SFE), Errored Second (ES), Severely Errored Second (SES), Bit Error Rate (BER), Error Free Second (EFS), UnAvailable Second (UAS), and Degraded Minute (DM). If no error parameter is specified all applicable parameters are displayed.

PORT: The PORT option specifies whether the DS1 – A port or DS1 – B port Performance Monitoring (PM) information is displayed. If no port is specified, information on both ports is displayed.

MONITOR: The MONITOR option lets the user take multiple "snapshots" or reports of PM information. To create multiple reports, enter MONITOR and then an integer *count* from 1 to 32k (32,767). The indicated lines are displayed *count* times in a row. Use this technique to quickly identify a trend in a particular parameter. This option is especially useful when used with CURRENT Bit Error Rate (BER) values to observe short-term fluctuations.

The format for PERFORMANCE command response begins with a header indicating each response field, followed by one or more lines displaying information for each PM parameter:

Example Screen:

9004B: Performance

Performance Monitoring Data

Port	En	From-time		To-time		L	E	I	Cd	PMP	Value	Threshold
DS1 – A	01	09:06	11/17	09:23	11/17	L	N	H	OK	CV =	0000000000	0000053360
DS1 – A	01	09:06	11/17	09:23	11/17	L	N	D	OK	CV =	0000000000	0000133400
DS1 – A	01	09:06	11/17	09:23	11/17	L	N	T	OK	CV =	0000000000	0001000000

Monitor data: The Performance Monitoring Data fields are:

PORT: Indicates whether information applies to the DS1 – A or the DS1 – B data stream.

PERFORMANCE (Continued)

ENTRY: Indicates which entry is shown. For HOURLY information, 24 entries are provided, numbered 01 to 24. DAILY information provides 7 entries numbered 01 to 07, and TOTAL information provides only one entry numbered 01. Entry 01 always refers to the entry being accumulated. All other entry numbers refer to completed past entries and are stored for future reference. (ENTRY 0 is also available for BER parameters only.)

From-Time To-Time: Indicates date and time of day to which all values refer. For 0 and 1 entries, To-Time is the current time and the accumulation is still in progress. For all other entries From-Time and To-Time specify an exact time interval during which the information was accumulated.

L or LAYER: Indicates whether the Performance Monitoring (PM) parameter applies to the LINE (L) or PATH (P) layer. LINE performance is based on BPVs, while PATH performance is based on CRC – 6 errors.

E or END: Indicates whether the Performance Monitoring parameter applies to the NEAR (N) or FAR (F) end. NEAR end parameters measure performance on received data, while FAR end parameters measure performance on transmitted data. Performance information on transmitted data is accessible by way of Performance Report Messages (PRMs) received each second.

I or INTERVAL: Indicates whether the Performance Monitoring parameter applies to the HOURLY (H), DAILY (D), or TOTAL (T) interval. In the case of the Bit Error Rate (BER) parameters, an additional interval, CURRENT (C), is provided due to the fact that HOURLY, DAILY and TOTAL BER values may not represent the error rate currently being experienced.

CD or CONDITION: Indicates the current condition of the Transmit/Receive ESF Unit (TREU). Valid entries for this field are Not Present (NP), Local Alarm (LA), Remote Alarm (RA), Degraded Performance (DP), or OK.

PMP or PERFORMANCE MONITORING PARAMETER: Indicates the PM parameter shown on this line. The parameters are Coding Violation (CV), Out Of Frame Second (OOF), Framing Error (FE), Severe Framing Errors (SFE), Errored Second (ES), Severely Errored Second (SES), Bit Error Rate (BER), Error Free Second (EFS), UnAvailable Second (UAS), and Degraded Minute (DM).

The next field is not labeled and contains either the =, <<, or > symbol. In some circumstances the exact value of a parameter cannot be specified and an inequality is given. For example, when the register maximum is reached, it is indicated as ES > 65535, or in the case of Bit Error Rate, if no errors occur in a given interval, it is indicated as BER.

PERFORMANCE (Continued)

VALUE: Indicates the value of a fully specified Performance Monitoring (PM) parameter. Values for ENTRY 0 and 1 may change each time they appear because they are accumulating current information. All other entries are fixed. This field is normally a number.

If an exceptional condition exists that makes a parameter unavailable, then ...NA... appears in the VALUE field for ENTRY 1 which displays each time they appear. Exceptional conditions include Transmit/Receive ESF Unit (TREU) not present, and thus no Performance Monitoring data is available, or no valid incoming Performance Report Messages (PRMs), and thus no FAR end data is available.

THRESHOLD: Indicates the appropriate current threshold value associated with this parameter. Threshold values are assigned default values by the RPIU at initialization. The user can change these default values at any time using the THRESHOLD command.

Interpreting BER Data

Current Bit Error Rate (BER) is based on the *average* time between errors and *average* errors per 3 ms read. This provides an indication of current and recent past error activity. However, this means that at initialization some assumption has to be made about past error activity. The RPIU assumes that no errors have been detected before initialization. The system therefore begins with a clean record and shows Current BER at its minimum value at initialization. Any subsequent errors are immediately tracked by Current BER as a running average value.

Parameter				Minimum	Maximum
L	N	H	BER	1.7991E-10	3.4542E-03
L	N	D	BER	7.4962E-12	3.4542E-03
L	N	T	BER	5.0266E-14	3.4542E-03
L	N	C	BER	5.0266E-14	3.4542E-03
L	N	H	BER	1.7991E-10	2.1589E-04
L	N	D	BER	7.4962E-12	2.1589E-04
L	N	T	BER	5.0266E-14	2.1589E-04
L	N	C	BER	5.0266E-14	2.1589E-04

BER minimum values depend on the time interval. This is due to the nature of BER itself. A single bit error in a one-hour period corresponds to a BER value of 1.7991E – 10 for the DS1 rate. A lower value cannot be inferred from only one hour's collection data. Similar reasoning limits the DAILY BER value to 7.4962E – 12.

PERFORMANCE (Continued)

TOTAL and CURRENT BER have the same minimum value due to the fact that this is limited by the system memory. Capacity is 4,294,967,295 x 3 ms ticks, or roughly 8 months. The minimum BER is 5.0266E-14. This corresponds to 1 bit error during this time. TOTAL BER is treated similarly to HOURLY and DAILY BER. Assuming no errors, ENTRY 0 values tend toward minimum value after initialization (that is, as the time frame increases) while ENTRY 1 values start at minimum value and remain there until errors are received.

Maximum BER values are based on 16 in 4632 error bits for LINE layer BER and 1 in 4632 error bits for PATH layer BER. At the DS1 rate, 4632 bits are received every 3 ms (or each ESF). The 4-bit BPV counter, with a maximum of 16, and the 1-bit CRC error counters are each read every 3 ms. These values are not reached in practice because the line or path is declared unavailable after 10 consecutive Severely Errored Seconds (SESs). Coding Violations (CVs) and Bit Error Rate (BER) are not updated during unavailable time.

In order to gauge the severity of errors corresponding to Bit Error Rate values, BER is related to the average time lapse between consecutive coding violations occurring on the span (apply only to one DS1 rate):

BER Value	Actual Value(s)	Approximate Value
1.0000E-03	6.4766839E-04	648 us
1.0000E-04	6.4766839E-03	7 ms
1.0000E-05	6.4766839E-02	65 ms
1.0000E-06	6.4766839E-01	648 ms
1.0000E-07	6.4766839E-00	7 seconds
1.0000E-08	6.4766839E+01	65 seconds
1.0000E-09	6.4766839E+02	11 minutes
1.0000E-10	6.4766839E+03	2 hours
1.0000E-11	6.4766839E+04	18 hours
1.0000E-12	6.4766839E+05	7 days
1.0000E-13	6.4766839E+06	2 months
1.0000E-14	6.4766839E+07	2 years

NOTE: It is assumed that the Extended Superframe format is used in most RPIU applications to maximize the utility of the link. However, it is possible that some applications use the standard DS1 Superframe format. If the standard Superframe format is used, PATH information is not available.

PERIODIC (PI)

Command: PERIODIC {s m command string}

The user can use the PERIODIC command to automatically and periodically enter up to 5 predetermined command strings every *m* number of minutes. For example, the PERIODIC command can request periodic display of PERFORMANCE information. The user can collect this information overnight via a printer and evaluate it in the morning. Any command can be automated in this way. The *command string* must be enclosed in quotes if it contains spaces. The integer *s* represents from 1 to 5 command strings. The integer *m* represents the number of minutes between successive command entries and its range is 1 to 65,535. If the command is used without options, any currently active automated command will appear along with its interval *m*.

Some useful intervals are:

Minutes	Duration
60	1 Hour
1,440	1 Day
10,080	1 Week
43,200	30 Days

NOTE: The PERIODIC command has a time interval default set for 10 seconds per command (adequate for most commands). If the command specified exceeds 10 seconds, then other PERIODIC slots may not be executed. Intervals should be long enough to allow time for a complete printout.

To review assigned command strings, enter the PERIODIC command without any parameters.

To clear any command string, enter the command PERIODIC {s} CLEAR, where s is any command string from 1 to 5.

STATUS (S)

Commands: STATUS {RPIU} {DS1 – A} {DS1 – B} {Default = ALL}

The user can use the STATUS command to display the current status of the RPIU or TREU cards. RPIU information includes Name (RPIU), Power Alarm (ON or OFF), and RPIU alarm (ON or OFF).

TREU information includes Name (DS1 – A or DS1 – B), Condition (Not Present, Local Alarm, Remote Alarm, Degraded Performance or OK), ON/OFF indications for the 6 loopback types, System Alarm, Local Alarm, Remote Alarm from the ACU (integrated over 1 second), Remote Alarm from the TREU (in parentheses: nonintegrated), ACO, DPLED, DPALM, AIS, OOF and LOS, and System Alarm Count. The STATUS display also indicates whether valid Performance Report Messages (PRMs) are being received from the far end.

Example Screen:

```
9004B: Status

Name: RPIU

Condition: OK

Power Alarm: OFF

RPIU Alarm: OFF

Name: DS1 – A                          Condition: OK

Loopbacks:          Alarms:          Trouble Conditions:
Line Local OFF      Local OFF            AIS OFF
Line Near OFF       Remote OFF           LOS OFF
Line Far OFF        DPLED OFF            OOF OFF

Path Local OFF      DPALM OFF
Path Near OFF       System OFF
Path Far OFF        ACO OFF

Incoming PRMs: YES

Local Alarm Count: 0

Remote Alarm Count: 0 (0)

System Alarm Count (CGS): 0

DS1 – B not present

9004B:
```

TIME (T)

Command: TIME

The TIME command displays the current system time and date.

User Entry: To view current time, enter TIME.

TROUBLE (TR)

Command: TROUBLE

The TROUBLE command displays information about existing trouble conditions, for example, Alarm Indication (AIS), Loss Of Signal (LOS),and Out Of Frame (OOF) conditions. The information given for each of these conditions is:

Current: ON or OFF in this field indicates whether the trouble condition is currently being experienced.

Events: The number of events reported for the trouble condition. Each event can last for 1 or more 3 ms reads, and for 1 or more seconds.

Reads: The RPIU looks for trouble conditions every 3 ms, which is the duration of a single Extended Superframe. The Reads field indicates the number of 3 ms read intervals during which the trouble condition was detected. Comparing the Reads value against the Events value gives the user the average duration of trouble condition events.

Seconds: The seconds register increments by 1 for each second during which the trouble condition is detected. For Loss Of Signal (LOS) and Out Of Frame (OOF), the UnAvailable Seconds (UAS) register is also increased by 1 second.

NOTE: The MONITOR mode TROUBLE command registers are cleared at system initialization or when the PERFORMANCE RESET command is used.

Example Screen:

9004B: Trouble

	Trouble Conditions		
	LOS	AIS	OOF
DS1 – A			
Current:	OFF	OFF	OFF
Events:	00000	00000	00000
Reads:	00000	00000	00000
Seconds:	00000	00000	00000
DS1 – B			
Current:	OFF	OFF	OFF
Events:	00000	00000	00000
Reads:	00000	00000	00000
Seconds:	00000	00000	00000

3. ADMINSTRATIVE COMMANDS

3.01 ADMINISTRATIVE commands can affect system traffic and are usually available only to those users assigned a password. The ADMINISTRATIVE mode is one level above the MONITOR mode and all commands listed in the MONITOR mode are available in this higher mode. The ADMINISTRATIVE commands in addition to those listed in the MONITOR mode are:

CONFIGURATION (modify)
DATE (update)
ERASE
HISTORY (clear)
LOOPBACK
NAME (modify)
PASSWORD
PERFORMANCE (reset)
RESET
THRESHOLD
TIME (update/stop)

CONFIGURATION (C)

Commands: CONFIGURATION {RPIU / DS1 – *n* / ALL}

CONFIGURATION DS1 – *n* [OVERRIDE state | B8ZS state | CLOCK new]

CONFIGURATION RPIU DP [Item] [State]
State = [ON | OFF]
Item = [DM | UAS | . . . LINE]

The CONFIGURATION command displays configuration information and lets the user modify certain items. The *n* in DS1 – *n* can be either A or B.

OVERRIDE: The CONFIGURATION OVERRIDE option lets the user set the B8ZS and CLOCK options. When software override is ON, both the B8ZS and CLOCK options can be changed using the CONFIGURATION command. Changes to the hardware straps for these items are ignored. When software override is OFF, the hardware straps determine these options and the CONFIGURATION command cannot affect them. OVERRIDE OFF is the default at initialization.

Bipolar 8 Zero Substitution (B8ZS): This option lets the user choose between two line coding schemes. If B8ZS is OFF, the standard Alternate Mark Inversion (AMI) line coding scheme is used. If B8ZS is ON, B8ZS line coding is used. This allows clear-channel transmission capability.

CLOCK: This option lets the user choose from three types of transmit clock. When the user specifies INTERNAL, an internally generated transmit clock is used. EXTERNAL selects an externally supplied transmit clock. LOOP selects a clock looped from the receive to the transmit side.

RPIU DP: The user can choose the events that lead to the Degraded Performance Alarm (DPALM). The DP LED lights when any PM threshold is crossed. The user enables or disables the thresholds in the DP mask by entering the *Item* (from the following list) and its *State* (ON or OFF).

Because the DP mask is stored in non-volatile memory, it is preserved during system resets unless the ERASE command is used.

CONFIGURATION (Continued)

CONFIGURATION RPIU DP lets the user change the Degraded Performance (DP) alarm mask. This mask determines which DP events cause a DP, or system alarm. The DP mask includes the following:

Item	Item Name
DM	Degraded Minutes
UAS	UnAvailable Seconds
ES	Errored Seconds
SFE	Severe Framing Error
FE	Framing Error
OOF	Out Of Frame Second
CV	Coding Violation
EFS	Error-Free Seconds
BER	Bit Error Rate
DS1 – A	DS1 Signal for Digroup A
DS1 – B	DS1 Signal for Digroup B
TOTAL	Total
DAILY	Daily
HOURLY	Hourly
CURRENT	Current
FAR	Far
NEAR	Near
PATH	Path
LINE	Line

DATE (D)

Command: DATE {mm / dd / yy}

The DATE command lets the user display and change the values for the real-time clock of the RPIU. If the user enters the command and does not specify a new date, the system displays its current time and date. If the user enters an incorrect value for any of the date fields, an error message appears and the system date remains unaltered. The date fields are:

mm:	month field: 1 to 12, January = 1
dd:	day field: 1 to 31
yy:	year field, 90 = 1990

User Entry: To set the current running date to July 4, 1990, for example, enter DATE 7/4/90.

ERASE (ERASE)

Command: ERASE {CANCEL}

This command clears the entire non-volatile memory of the RPIU. This returns the system to its default values. The command does not actually perform the erasure, but sets a flag for the software to do it during the next system reset. Thus the command may be undone by using the ERASE CANCEL before the next reset. This command is usually used only when the RPIU is initially installed in a system.

NOTE: The ERASE command does not clear the time or date.

HISTORY (HI)

Command: HISTORY {SOFTWARE} {CLEAR}

If the user specifies only the CLEAR option, HISTORY clears out the alarm history table. If both the SOFTWARE and CLEAR options are used, then the software history table is cleared.

LOOPBACK (LO)

Command: LOOPBACK [Layer] [Location] [DS1 – *n*] {CANCEL}

LOOPBACK activates and deactivates the various forms of loopback capability available. When specifying the layer option the user can specify LINE or PATH. The layer option specifies the layer where the loop is accomplished. A LINE loopback loops data and framing information. PATH loopback loops only the data or payload.

The Location option can be LOCAL, NEAR, or FAR. The *n* specifies the digroup A or B. Valid combinations are:

(a) LOOPBACK LINE LOCAL DS1 – *n*

(b) LOOPBACK LINE NEAR DS1 – *n*

(c) LOOPBACK PATH NEAR DS1 – *n*

(d) LOOPBACK PATH LOCAL DS1 – *n*

(e) LOOPBACK LINE FAR DS1 – *n*

(f) LOOPBACK PATH FAR DS1 – *n*

NOTE: For a detailed discussion of the various forms of loopback, refer to Practice 342-911-133.

Verification is provided for both LINE and PATH loopback at the FAR end. After initiating continuous transmission of the appropriate bit-oriented message via overhead datalink (ESF only), the RPIU waits for a verification of completion from the far end. If verification is received within 10 seconds, the RPIU discontinues transmission of the bit-oriented message and prints a command response message to the CRT or RS-232 port, such as

DS1 – B LINE FAR LOOPBACK ACTIVATED

If no verification is received within 10 seconds, transmission of the bit-oriented message is also discontinued. The message

*** Timeout ... No Verification ***

is sent to the CRT. The loop lamp on the ACU operates only when the LINE LOCAL loopback is active; this is equivalent to pushing the loop button on the ACU.

NAME (N)

Command: NAME NODE {node name}

The NAME command changes the name of the node. At system installation, the node name does not exist and the default prompt 9004B: appears. The node name is displayed each time the user enters the CONFIGURATION command. When the name is changed, the new name is stored in non-volatile memory.

A name can contain up to 26 characters and must be enclosed in quotation marks if it contains spaces.

User Entry: To name a node, for example, PHX01 at 1234 Adams Street, enter NAME NODE

"PHX01 AT 1234 ADAMS STREET".

NOTE: The first 5 characters of the node name become the prompt, for example, PHX01.

PASSWORD (PW)

Command: PASSWORD [new-password]

This command changes the password of the ADMINISTRATIVE mode. The password must contain at least four and no more than eight characters. Only alphanumeric characters (A through Z and 0 through 9) are allowed. The system is installed without an ADMINISTRATIVE mode password default.

User Entry: To change the password, for example, to Z6ABF, enter PASSWORD and then enter Z6ABF when prompted for the password. When changing the password, delete unwanted characters using the BACKSPACE key.

When entering the password at the password prompt at the beginning of a session on the RPIU, the user cannot use the BACKSPACE key to erase unwanted characters. If the BACKSPACE is used, the password is rejected.

NOTE: If the password is forgotten, contact Siemens Communication Systems, Inc., Carrier Products Group, Technical Services for assistance.

PERFORMANCE (P)

Command: PERFORMANCE RESET

The PERFORMANCE RESET command lets the user reset all currently accumulating Performance Monitoring (PM), that is ENTRY 01, and begin a new counting sequence. All current ENTRY 01 information becomes ENTRY 02 information and no data is lost. This command also eliminates the DPLED and DPALM conditions if they are present. An example of the use of this command is after a DPLED or DPALM condition has been declared. This command can be used to synchronize data collection time intervals with other products. Execution of the PERFORMANCE RESET command will discontinue the alarm. The user can then query ENTRY 02 information to determine what caused the alarm.

NOTE: The PERFORMANCE RESET command has no effect on past Performance Monitoring entries; however, TROUBLE information is reset.

RESET (RES)

Command: RESET

The RESET command resets the RPIU which then runs its initialization program. After the system initialization completion message appears, press the RETURN key to reconnect.

User Entry: To reset and initialize the RPIU, enter RESET.

The RESET command forces the microprocessor to halt which causes the watchdog timer to fire. The RPIU then goes through initialization. Pressing the RETURN key reconnects the user. Trouble registers and performance registers are reset.

NOTE: A system reset does not affect non-volatile memory unless the ERASE command was previously used.

Example Screen:

```
9004B: RESET

09:06:20  11/17/89 RPIU Reset 0

* * * System Halted * * *



* * * System Initialization Started * * *
* * * System Initialization Completed * * *
Connection established to 9004B ESF
```

THRESHOLD (THR)

Command: THRESHOLD [Layer] [Interval] [Parameter] [Port] [Value]

The THRESHOLD command changes the Performance Monitoring (PM) threshold values. Each threshold is assigned a default value during system startup. If any of these threshold values are exceeded, a DPLED alarm and message are generated. At any time, the user can change any of these thresholds using the THRESHOLD command. When the THRESHOLD command is entered, the information is stored in non-volatile memory and is therefore preserved during system resets.

Whenever a threshold is exceeded, the Degraded Performance LED for the appropriate digroup on the RPIU faceplate lights and an asynchronous message is generated to the RS-232 port. If the corresponding fields in the DP mask are enabled, a DP Alarm is generated causing a digroup System Alarm.

NOTE: Unlike the other commands, all parameters must be supplied with the THRESHOLD command. Notice that the END, that is NEAR or FAR, is not specified since the thresholds are common to both.

Layer: The Layer field specifies whether a LINE or PATH threshold is being changed.

Interval: The Interval field specifies the HOURLY, DAILY, TOTAL, or CURRENT interval threshold.

Parameter: The Parameter field specifies which Performance Monitoring (PM) threshold the change applies to (CV, BER, EFS, OOF, FE, SFE, ES, SES, UAS, or DM).

Port: The Port field specifies either the DS1 – A port or the DS1 – B port.

Value: The Value parameter specifies the NEW value for the fully specified threshold. For most parameters the value field is a string of digits; however, there are two exceptions. For the BER parameter, the value field must be of the form X.YE-Z, and for the EFS feature, the value must be of the form X.Y. The parser looks for the special characters ".", E, and "-", in order to interpret the number.

THRESHOLD (Continued)

Minimum and maximum values for each class of parameter are:

Parameter	Best Case	Worst Case
CV	0	4,294,967,295
BER (L N C)	5.0266E – 14	3.4542E – 03
BER (L N H)	1.7991E – 10	3.4542E – 03
BER (L N D)	7.4962E – 12	3.4542E – 03
BER (L N T)	5.0266E – 14	3.4542E – 03
BER (L N C)	5.0266E – 14	2.1589E – 04
BER (L N H)	1.7991E – 10	2.1589E – 04
BER (L N D)	7.4962E – 12	2.1589E – 04
BER (L N T)	5.0266E – 14	2.1589E – 04
EFS	100.00%	0.0 %
All others	0	65,535

If the threshold is set to the best-case value, this establishes the most sensitive error detection. In this case the threshold is tripped by a single error. At the other extreme, if the threshold is set at the worst-case value, the threshold mechanism is effectively disabled. In all cases, the threshold is tripped only if a parameter value is worse than, not equal to, its corresponding threshold value.

TIME (T)

Command: TIME { hh : mm | STOP }

The TIME command changes the current time of the system. The *hh* parameter is the hours in military format, that is 0 to 23. The *mm* is the minutes, which range from 0 to 59. The STOP option stops the real-time clock device. This causes the device to consume less battery power and is highly recommended prior to any extended storage period. At the next reset, the clock is automatically restarted and set to 12:00 on 01/01/89.

4. ASYNCHRONOUS MESSAGES

4.01 Asynchronous or unsolicited messages are those that are not generated as a result of user interaction. If the user enters a command and receives a message, this message is synchronous, or a solicited message.

4.02 Asynchronous output in the system is sent to the CRT interface to be generated as messages. The 9004 system includes messages in different formats. Each format adheres to the principle that what is provided is the minimal amount of information needed at the time of the event, because, in all cases, further information is available through various database searches. The form for all asynchronous messages is:

HH:MM:SS MM/DD/YY port:message

where HH:MM:SS MM/DD/YY is the time stamp and port is DS – 1A, DS1 – B, or TBOS. The message field is any one of the values listed:

'layer' 'end' 'int' 'parm' Threshold Exceeded
Degraded Performance LED
Degraded Performance Alarm
Card Inserted
Card Removed
Configuration Changed

'alarm – type' Alarm {CLEAR}
Test Tone {ON/OFF}
Local Loop {ON/OFF}
Bit Message 0xxxxxx0 Received, (x = 1 or 0
Command xx Received ($00 \leqq xx \leqq 63$)

for which the following information is valid:

'layer' is either LINE or PATH
'end' is either NEAR or FAR
'int' is HOURLY, DAILY, TOTAL, or CURRENT
'parm' is CV, OOF, FE, SFE, ES, SES, UAS, DM, BER, or EFS
'alarm – type' is SYSTEM, LOCAL, REMOTE, or POWER.

5. FACEPLATE INDICATORS

5.01 The RPIU faceplate includes 3 LED indicators: the RPIU ALARM LED (red), and two DEGRADED PERFORMANCE LEDs (yellow).

5.02 The RPIU ALARM LED lights whenever the product is initialized and remains lighted until initialization is properly completed. If a problem occurs during this procedure, the LED will blink. Whenever possible, messages that explain the failure are sent to the RS-232 port.

5.03 The DEGRADED PERFORMANCE LEDs light whenever a PM threshold has been exceeded. The event history table should also contain a message specifying the threshold exceeded. The LED lights regardless of whether the DP alarm has been activated, and the DP alarm activates depending on which items are enabled or disabled in the DP mask (see ADMINISTRATIVE CONFIGURATION command). The upper yellow LED is for digroup B (port DS1 – B) and the lower one is for digroup A (port DS1 – A).

6. RS-422 TBOS INTERFACE

6.01 The RPIU supports an RS-422 TBOS interface. This port is provided as an interface to the OSS. It implements the TBOS protocol defined in Bellcore TA-TSY-000149. Available commands and information for interpreting scanned bit-fields are shown in the 9004B ESF TBOS TABLE.

9004B ESF TBOS TABLE

D = Display C = Character

D	C	Position	Description
0	0	xxxxxxx1	LINE DS1 – A NEAR HOURLY ALARM CV
0	0	xxxxxx1x	LINE DS1 – A NEAR HOURLY ALARM ES
0	0	xxxxx1xx	LINE DS1 – A NEAR HOURLY ALARM S ES
0	0	xxxx1xxx	unused
0	0	xxx1xxxx	unused
0	0	xx1xxxxx	unused
0	0	x1xxxxxx	unused
0	0	1xxxxxxx	unused
0	1	xxxxxxx1	LINE DS1 – A NEAR DAILY ALARMS CV
0	1	xxxxxx1x	LINE DS1 – A NEAR DAILY ALARM ES
0	1	xxxxx1xx	LINE DS1 – A NEAR DAILY ALARMS SES
0	1	xxxx1xxx	unused
0	1	xxx1xxxx	unused
0	1	xx1xxxxx	unused
0	1	x1xxxxxx	unused
0	1	1xxxxxxx	unused
0	2	xxxxxxx1	LINE DS1 – A NEAR TOTAL ALARMS CV
0	2	xxxxxx1x	LINE DS1 – A NEAR TOTAL ALARMS ES
0	2	xxxxx1xx	LINE DS1 – A NEAR TOTAL ALARMS SES
0	2	xxxx1xxx	unused
0	2	xxx1xxxx	unused
0	2	xx1xxxxx	unused
0	2	x1xxxxxx	unused
0	2	1xxxxxxx	unused

0	3	xxxxxxx1	LINE DS1 – A FAR HOURLY ALARMS CV
0	3	xxxxxx1x	LINE DS1 – A FAR HOURLY ALARMS ES
0	3	xxxxx1xx	LINE DS1 – A FAR HOURLY ALARMS SES
0	3	xxxx1xxx	unused
0	3	xxx1xxxx	unused
0	3	xx1xxxxx	unused
0	3	x1xxxxxx	unused
0	3	1xxxxxxx	unused
0	4	xxxxxxx1	LINE DS1 – A FAR DAILY ALARMS CV
0	4	xxxxxx1x	LINE DS1 – A FAR DAILY ALARMS ES
0	4	xxxxx1xx	LINE DS1 – A FAR DAILY ALARMS SES
0	4	xxxx1xxx	unused
0	4	xxx1xxxx	unused
0	4	xx1xxxxx	unused
0	4	x1xxxxxx	unused
0	4	1xxxxxxx	unused
0	5	xxxxxxx1	LINE DS1 – A FAR TOTAL ALARMS CV
0	5	xxxxxx1x	LINE DS1 – A FAR TOTAL ALARMS ES
0	5	xxxxx1xx	LINE DS1 – A FAR TOTAL ALARMS SES
0	5	xxxx1xxx	unused
0	5	xxx1xxxx	unused
0	5	xx1xxxxx	unused
0	5	x1xxxxxx	unused
0	5	1xxxxxxx	unused
0	6	xxxxxxx1	DS1 – A LOS
0	6	xxxxxx1x	DS1 – A AIS
0	6	xxxxx1xx	DS1 – A OOF
0	6	xxxx1xxx	DS1 – A Card Removed
0	6	xxx1xxxx	DS1 – A Local Alarm
0	6	xx1xxxxx	DS1 – A Remote Alarm
0	6	x1xxxxxx	DS1 – A Degraded Performance Alarm
0	6	1xxxxxxx	DS1 – A ACO
0	7	xxxxxxx1	DS1 – A Line Local Loopback
0	7	xxxxxx1x	DS1 – A Line Near Loopback
0	7	xxxxx1xx	DS1 – A Path Near Loopback
0	7	xxxx1xxx	DS1 – A Line Far Loopback
0	7	xxx1xxxx	DS1 – A Path Far Loopback
0	7	xx1xxxxx	DS1 – A Degraded Performance LED
0	7	x1xxxxxx	DS1 – A Path Local Loopback
0	7	1xxxxxxx	DS1 – A System Alarm

1	0	xxxxxxx1	PATH DS1 – A NEAR HOURLY ALARMS CV
1	0	xxxxxx1x	PATH DS1 – A NEAR HOURLY ALARMS ES
1	0	xxxxx1xx	PATH DS1 – A NEAR HOURLY ALARMS SES
1	0	xxxx1xxx	PATH DS1 – A NEAR HOURLY ALARMS FE
1	0	xxx1xxxx	PATH DS1 – A NEAR HOURLY ALARMS SFE
1	0	xx1xxxxx	PATH DS1 – A NEAR HOURLY ALARMS OOF
1	0	x1xxxxxx	PATH DS1 – A NEAR HOURLY ALARMS UAS
1	0	1xxxxxxx	PATH DS1 – A NEAR HOURLY ALARMS DM
1	1	xxxxxxx1	PATH DS1 – A NEAR DAILY ALARMS C
1	1	xxxxxx1x	PATH DS1 – A NEAR DAILY ALARMS E
1	1	xxxxx1xx	PATH DS1 – A NEAR DAILY ALARMS SES
1	1	xxxx1xxx	PATH DS1 – A NEAR DAILY ALARMS FE
1	1	xxx1xxxx	PATH DS1 – A NEAR DAILY ALARMS SFE
1	1	xx1xxxxx	PATH DS1 – A NEAR DAILY ALARMS OOF
1	1	x1xxxxxx	PATH DS1 – A NEAR DAILY ALARMS UAS
1	1	1xxxxxxx	PATH DS1 – A NEAR DAILY ALARMS DM
1	2	xxxxxxx1	PATH DS1 – A NEAR TOTAL ALARMS CV
1	2	xxxxxx1x	PATH DS1 – A NEAR TOTAL ALARMS ES
1	2	xxxxx1xx	PATH DS1 – A NEAR TOTAL ALARMS SES
1	2	xxxx1xxx	PATH DS1 – A NEAR TOTAL ALARMS FE
1	2	xxx1xxxx	PATH DS1 – A NEAR TOTAL ALARMS SFE
1	2	xx1xxxxx	PATH DS1 – A NEAR TOTAL ALARMS OOF
1	2	x1xxxxxx	PATH DS1 – A NEAR TOTAL ALARMS UAS
1	2	1xxxxxxx	PATH DS1 – A NEAR TOTAL ALARMS DM
1	3	xxxxxxx1	PATH DS1 – A FAR HOURLY ALARMS CV
1	3	xxxxxx1x	PATH DS1 – A FAR HOURLY ALARMS ES
1	3	xxxxx1xx	PATH DS1 – A FAR HOURLY ALARMS SES
1	3	xxxx1xxx	PATH DS1 – A FAR HOURLY ALARMS FE
1	3	xxx1xxxx	PATH DS1 – A FAR HOURLY ALARMS SFE
1	3	xx1xxxxx	PATH DS1 – A FAR HOURLY ALARMS OOF
1	3	x1xxxxxx	PATH DS1 – A FAR HOURLY ALARMS UAS
1	3	1xxxxxxx	PATH DS1 – A FAR HOURLY ALARMS DM
1	4	xxxxxxx1	PATH DS1 – A FAR DAILY ALARMS CV
1	4	xxxxxx1x	PATH DS1 – A FAR DAILY ALARMS ES
1	4	xxxxx1xx	PATH DS1 – A FAR DAILY ALARMS SES
1	4	xxxx1xxx	PATH DS1 – A FAR DAILY ALARMS FE
1	4	xxx1xxxx	PATH DS1 – A FAR DAILY ALARMS SFE
1	4	xx1xxxxx	PATH DS1 – A FAR DAILY ALARMS OOF
1	4	x1xxxxxx	PATH DS1 – A FAR DAILY ALARMS UAS
1	4	1xxxxxxx	PATH DS1 – A FAR DAILY ALARMS DM

1	5	xxxxxxx1	PATH DS1 – A FAR TOTAL ALARMS CV
1	5	xxxxxx1x	PATH DS1 – A FAR TOTAL ALARMS ES
1	5	xxxxx1xx	PATH DS1 – A FAR TOTAL ALARMS SES
1	5	xxxx1xxx	PATH DS1 – A FAR TOTAL ALARMS FE
1	5	xxx1xxxx	PATH DS1 – A FAR TOTAL ALARMS SFE
1	5	xx1xxxxx	PATH DS1 – A FAR TOTAL ALARMS OOF
1	5	x1xxxxxx	PATH DS1 – A FAR TOTAL ALARMS UAS
1	5	1xxxxxxx	PATH DS1 – A FAR TOTAL ALARMS DM
1	6	xxxxxxx1	DS1 – A LB01
1	6	xxxxxx1x	DS1 – A LB02
1	6	xxxxx1xx	DS1 – A LB03
1	6	xxxx1xxx	RPIU Power Alarm
1	6	xxx1xxxx	RPIU Alarm
1	6	xx1xxxxx	DS1 – A B8ZS
1	6	x1xxxxxx	DS1 – A LPCLK
1	6	1xxxxxxx	DS1 – A EXTCLK
1	7	xxxxxxx1	DS1 – A M1SEL
1	7	xxxxxx1x	DS1 – A M2SEL
1	7	xxxxx1xx	DS1 – A D1D SEL
1	7	xxxx1xxx	DS1 – A D2 SEL
1	7	xxx1xxxx	DS1 – A ESF ON
1	7	xx1xxxxx	DS1 – A SIG INH
1	7	x1xxxxxx	DS1 – A MAN LB
1	7	1xxxxxxx	DS1 – A TONE OFF
2	0	xxxxxxx1	LINE DS1 – B NEAR HOURLY ALARMS CV
2	0	xxxxxx1x	LINE DS1 – B NEAR HOURLY ALARMS ES
2	0	xxxxx1xx	LINE DS1 – B NEAR HOURLY ALARMS SES
2	0	xxxx1xxx	unused
2	0	xxx1xxxx	unused
2	0	xx1xxxxx	unused
2	0	x1xxxxxx	unused
2	0	1xxxxxxx	unused
2	1	xxxxxxx1	LINE DS1 – B NEAR DAILY ALARMS CV
2	1	xxxxxx1x	LINE DS1 – B NEAR DAILY ALARMS ES
2	1	xxxxx1xx	LINE DS1 – B NEAR DAILY ALARMS SES
2	1	xxxx1xxx	unused
2	1	xxx1xxxx	unused
2	1	xx1xxxxx	unused
2	1	x1xxxxxx	unused
2	1	1xxxxxxx	unused

2	2	xxxxxxx1	LINE DS1 – B NEAR TOTAL ALARMS CV
2	2	xxxxxx1x	LINE DS1 – B NEAR TOTAL ALARMS ES
2	2	xxxxx1xx	LINE DS1 – B NEAR TOTAL ALARMS SES
2	2	xxxx1xxx	unused
2	2	xxx1xxxx	unused
2	2	xx1xxxxx	unused
2	2	x1xxxxxx	unused
2	2	1xxxxxxx	unused
2	3	xxxxxxx1	LINE DS1 – B FAR HOURLY ALARMS CV
2	3	xxxxxx1x	LINE DS1 – B FAR HOURLY ALARMS ES
2	3	xxxxx1xx	LINE DS1 – B FAR HOURLY ALARMS SES
2	3	xxxx1xxx	unused
2	3	xxx1xxxx	unused
2	3	xx1xxxxx	unused
2	3	x1xxxxxx	unused
2	3	1xxxxxxx	unused
2	4	xxxxxxx1	LINE DS1 – B FAR DAILY ALARMS CV
2	4	xxxxxx1x	LINE DS1 – B FAR DAILY ALARMS ES
2	4	xxxxx1xx	LINE DS1 – B FAR DAILY ALARMS SES
2	4	xxxx1xxx	unused
2	4	xxx1xxxx	unused
2	4	xx1xxxxx	unused
2	4	x1xxxxxx	unused
2	4	1xxxxxxx	unused
2	5	xxxxxxx1	LINE DS1 – B FAR TOTAL ALARMS CV
2	5	xxxxxx1x	LINE DS1 – B FAR TOTAL ALARMS ES
2	5	xxxxx1xx	LINE DS1 – B FAR TOTAL ALARMS SES
2	5	xxxx1xxx	unused
2	5	xxx1xxxx	unused
2	5	xx1xxxxx	unused
2	5	x1xxxxxx	unused
2	5	1xxxxxxx	unused
2	6	xxxxxxx1	DS1 – B LOS
2	6	xxxxxx1x	DS1 – B AIS
2	6	xxxxx1xx	DS1 – B OOF
2	6	xxxx1xxx	DS1 – B Card Removed
2	6	xxx1xxxx	DS1 – B Local Alarm
2	6	xx1xxxxx	DS1 – B Remote Alarm
2	6	x1xxxxxx	DS1 – B Degraded Performance Alarm
2	6	1xxxxxxx	DS1 – B ACO

2	7	xxxxxxx1	DS1 – B Line Local Loopback
2	7	xxxxxx1x	DS1 – B Line Near Loopback
2	7	xxxxx1xx	DS1 – B Path Near Loopback
2	7	xxxx1xxx	DS1 – B Line Far Loopback
2	7	xxx1xxxx	DS1 – B Path Far Loopback
2	7	xx1xxxxx	DS1 – B Degraded Performance LED
2	7	x1xxxxxx	DS1 – B Path Local Loopback
2	7	1xxxxxxx	DS1 – B System Alarm
3	0	xxxxxxx1	PATH DS1 – B NEAR HOURLY ALARMS CV
3	0	xxxxxx1x	PATH DS1 – B NEAR HOURLY ALARMS ES
3	0	xxxxx1xx	PATH DS1 – B NEAR HOURLY ALARMS SES
3	0	xxxx1xxx	PATH DS1 – B NEAR HOURLY ALARMS FE
3	0	xxx1xxxx	PATH DS1 – B NEAR HOURLY ALARMS SFE
3	0	xx1xxxxx	PATH DS1 – B NEAR HOURLY ALARMS OOF
3	0	x1xxxxxx	PATH DS1 – B NEAR HOURLY ALARMS UAS
3	0	1xxxxxxx	PATH DS1 – B NEAR HOURLY ALARMS DM
3	1	xxxxxxx1	PATH DS1 – B NEAR DAILY ALARMS CV
3	1	xxxxxx1x	PATH DS1 – B NEAR DAILY ALARMS ES
3	1	xxxxx1xx	PATH DS1 – B NEAR DAILY ALARMS SES
3	1	xxxx1xxx	PATH DS1 – B NEAR DAILY ALARMS FE
3	1	xxx1xxxx	PATH DS1 – B NEAR DAILY ALARMS SFE
3	1	xx1xxxxx	PATH DS1 – B NEAR DAILY ALARMS OOF
3	1	x1xxxxxx	PATH DS1 – B NEAR DAILY ALARMS UAS
3	1	1xxxxxxx	PATH DS1 – B NEAR DAILY ALARMS DM
3	2	xxxxxxx1	PATH DS1 – B NEAR TOTAL ALARMS CV
3	2	xxxxxx1x	PATH DS1 – B NEAR TOTAL ALARMS ES
3	2	xxxxx1xx	PATH DS1 – B NEAR TOTAL ALARMS SES
3	2	xxxx1xxx	PATH DS1 – B NEAR TOTAL ALARMS FE
3	2	xxx1xxxx	PATH DS1 – B NEAR TOTAL ALARMS SFE
3	2	xx1xxxxx	PATH DS1 – B NEAR TOTAL ALARMS OOF
3	2	x1xxxxxx	PATH DS1 – B NEAR TOTAL ALARMS UAS
3	2	1xxxxxxx	PATH DS1 – B NEAR TOTAL ALARMS DM
3	3	xxxxxxx1	PATH DS1 – B FAR HOURLY ALARMS CV
3	3	xxxxxx1x	PATH DS1 – B FAR HOURLY ALARMS ES
3	3	xxxxx1xx	PATH DS1 – B FAR HOURLY ALARMS SES
3	3	xxxx1xxx	PATH DS1 – B FAR HOURLY ALARMS FE
3	3	xxx1xxxx	PATH DS1 – B FAR HOURLY ALARMS SFE
3	3	xx1xxxxx	PATH DS1 – B FAR HOURLY ALARMS OOF
3	3	x1xxxxxx	PATH DS1 – B FAR HOURLY ALARMS UAS
3	3	1xxxxxxx	PATH DS1 – B FAR HOURLY ALARMS DM

3	4	xxxxxxx1	PATH DS1 – B FAR DAILY ALARMS CV
3	4	xxxxxx1x	PATH DS1 – B FAR DAILY ALARMS ES
3	4	xxxxx1xx	PATH DS1 – B FAR DAILY ALARMS SES
3	4	xxxx1xxx	PATH DS1 – B FAR DAILY ALARMS FE
3	4	xxx1xxxx	PATH DS1 – B FAR DAILY ALARMS SFE
3	4	xx1xxxxx	PATH DS1 – B FAR DAILY ALARMS OOF
3	4	x1xxxxxx	PATH DS1 – B FAR DAILY ALARMS UAS
3	4	1xxxxxxx	PATH DS1 – B FAR DAILY ALARMS DM
3	5	xxxxxxx1	PATH DS1 – B FAR TOTAL ALARMS CV
3	5	xxxxxx1x	PATH DS1 – B FAR TOTAL ALARMS ES
3	5	xxxxx1xx	PATH DS1 – B FAR TOTAL ALARMS SES
3	5	xxxx1xxx	PATH DS1 – B FAR TOTAL ALARMS FE
3	5	xxx1xxxx	PATH DS1 – B FAR TOTAL ALARMS SFE
3	5	xx1xxxxx	PATH DS1 – B FAR TOTAL ALARMS OOF
3	5	x1xxxxxx	PATH DS1 – B FAR TOTAL ALARMS UAS
3	5	1xxxxxxx	PATH DS1 – B FAR TOTAL ALARMS DM
3	6	xxxxxxx1	DSB1 – B LB01
3	6	xxxxxx1x	DSB1 – B LB02
3	6	xxxxx1xx	DSB1 – B LB03
3	6	xxxx1xxx	unused
3	6	xxx1xxxx	unused
3	6	xx1xxxxx	DSB1 – B B8ZS
3	6	x1xxxxxx	DSB1 – B LPCLK
3	6	1xxxxxxx	DSB1 – B EXTCLK
3	7	xxxxxxx1	DSB1 – B M1SEL
3	7	xxxxxx1x	DSB1 – B M2SEL
3	7	xxxxx1xx	DSB1 – B D1D SEL
3	7	xxxx1xxx	DSB1 – B D2 SEL
3	7	xxx1xxxx	DSB1 – B ESF ON
3	7	xx1xxxxx	DSB1 – B SIG INH
3	7	x1xxxxxx	DSB1 – B MAN LB
3	7	1xxxxxxx	DSB1 – B TONE OFF
4	0	xxxxxxx1	LINE DS1 – A NEAR HOURLY ALARMS BER
4	0	xxxxxx1x	LINE DS1 – A NEAR HOURLY ALARMS EFS
4	0	xxxxx1xx	unused
4	0	xxxx1xxx	unused
4	0	xxx1xxxx	unused
4	0	xx1xxxxx	unused
4	0	x1xxxxxx	unused
4	0	1xxxxxxx	unused

4	1	xxxxxxx1	LINE DS1 – A NEAR DAILY ALARMS BER
4	1	xxxxxx1x	LINE DS1 – A NEAR DAILY ALARMS EFS
4	1	xxxxx1xx	unused
4	1	xxxx1xxx	unused
4	1	xxx1xxxx	unused
4	1	xx1xxxxx	unused
4	1	x1xxxxxx	unused
4	1	1xxxxxxx	unused
4	2	xxxxxxx1	LINE DS1 – A NEAR TOTAL ALARMS BER
4	2	xxxxxx1x	LINE DS1 – A NEAR TOTAL ALARMS EFS
4	2	xxxxx1xx	unused
4	2	xxxx1xxx	unused
4	2	xxx1xxxx	unused
4	2	xx1xxxxx	unused
4	2	x1xxxxxx	unused
4	2	1xxxxxxx	unused
4	3	xxxxxxx1	LINE DS1 – A FAR HOURLY ALARMS BER
4	3	xxxxxx1x	LINE DS1 – A FAR HOURLY ALARMS EFS
4	3	xxxxx1xx	unused
4	3	xxxx1xxx	unused
4	3	xxx1xxxx	unused
4	3	xx1xxxxx	unused
4	3	x1xxxxxx	unused
4	3	1xxxxxxx	unused
4	4	xxxxxxx1	LINE DS1 – A FAR DAILY ALARMS BER
4	4	xxxxxx1x	LINE DS1 – A FAR DAILY ALARMS EFS
4	4	xxxxx1xx	unused
4	4	xxxx1xxx	unused
4	4	xxx1xxxx	unused
4	4	xx1xxxxx	unused
4	4	x1xxxxxx	unused
4	4	1xxxxxxx	unused
4	5	xxxxxxx1	LINE DS1 – A FAR TOTAL ALARMS BER
4	5	xxxxxx1x	LINE DS1 – A FAR TOTAL ALARMS EFS
4	5	xxxxx1xx	unused
4	5	xxxx1xxx	unused
4	5	xxx1xxxx	unused
4	5	xx1xxxxx	unused
4	5	x1xxxxxx	unused
4	5	1xxxxxxx	unused

4	6	xxxxxxx1	LINE DS1 – A NEAR CURRENT ALARMS BER
4	6	xxxxxx1x	unused
4	6	xxxxx1xx	unused
4	6	xxxx1xxx	unused
4	6	xxx1xxxx	unused
4	6	xx1xxxxx	unused
4	6	x1xxxxxx	unused
4	6	1xxxxxxx	unused
4	7	xxxxxxx1	DP Mask bit 4 (SFE)
4	7	xxxxxx1x	DP Mask bit 5 (FE)
4	7	xxxxx1xx	DP Mask bit 6 (OOF)
4	7	xxxx1xxx	DP Mask bit 7 (CV)
4	7	xxx1xxxx	DP Mask bit 8 (EFS)
4	7	xx1xxxxx	DP Mask bit 9 (BER)
4	7	x1xxxxxx	DP Mask bit 10 (DS1 – B)
4	7	1xxxxxxx	DP Mask bit 11 (DS1 – A)
5	0	xxxxxxx1	PATH DS1 – A NEAR HOURLY ALARMS BER
5	0	xxxxxx1x	PATH DS1 – A NEAR HOURLY ALARMS EFS
5	0	xxxxx1xx	unused
5	0	xxxx1xxx	unused
5	0	xxx1xxxx	unused
5	0	xx1xxxxx	unused
5	0	x1xxxxxx	unused
5	0	1xxxxxxx	unused
5	1	xxxxxxx1	PATH DS1 – A NEAR DAILY ALARMS BER
5	1	xxxxxx1x	PATH DS1 – A NEAR DAILY ALARMS EFS
5	1	xxxxx1xx	unused
5	1	xxxx1xxx	unused
5	1	xxx1xxxx	unused
5	1	xx1xxxxx	unused
5	1	x1xxxxxx	unused
5	1	1xxxxxxx	unused
5	2	xxxxxxx1	PATH DS1 – A NEAR TOTAL ALARMS BER
5	2	xxxxxx1x	PATH DS1 – A NEAR TOTAL ALARMS EFS
5	2	xxxxx1xx	unused
5	2	xxxx1xxx	unused
5	2	xxx1xxxx	unused
5	2	xx1xxxxx	unused
5	2	x1xxxxxx	unused
5	2	1xxxxxxx	unused

5	3	xxxxxxx1	PATH DS1 – A FAR HOURLY ALARMS BER
5	3	xxxxxx1x	PATH DS1 – A FAR HOURLY ALARMS EFS
5	3	xxxxx1xx	unused
5	3	xxxx1xxx	unused
5	3	xxx1xxxx	unused
5	3	xx1xxxxx	unused
5	3	x1xxxxxx	unused
5	3	1xxxxxxx	unused
5	4	xxxxxxx1	PATH DS1 – A FAR DAILY ALARMS BER
5	4	xxxxxx1x	PATH DS1 – A FAR DAILY ALARMS EFS
5	4	xxxxx1xx	unused
5	4	xxxx1xxx	unused
5	4	xxx1xxxx	unused
5	4	xx1xxxxx	unused
5	4	x1xxxxxx	unused
5	4	1xxxxxxx	unused
5	5	xxxxxxx1	PATH DS1 – A FAR TOTAL ALARMS BER
5	5	xxxxxx1x	PATH DS1 – A FAR TOTAL ALARMS EFS
5	5	xxxxx1xx	unused
5	5	xxxx1xxx	unused
5	5	xxx1xxxx	unused
5	5	xx1xxxxx	unused
5	5	x1xxxxxx	unused
5	5	1xxxxxxx	unused
5	6	xxxxxxx1	PATH DS1 – A NEAR CURRENT ALARMS BER
5	6	xxxxxx1x	unused
5	6	xxxxx1xx	unused
5	6	xxxx1xxx	unused
5	6	xxx1xxxx	unused
5	6	xx1xxxxx	unused
5	6	x1xxxxxx	unused
5	6	1xxxxxxx	unused
5	7	xxxxxxx1	unused
5	7	xxxxxx1x	unused
5	7	xxxxx1xx	unused
5	7	xxxx1xxx	unused
5	7	xxx1xxxx	unused
5	7	xx1xxxxx	unused
5	7	x1xxxxxx	unused
5	7	1xxxxxxx	unused

6	0	xxxxxxx1	LINE DS1 – B NEAR HOURLY ALARMS BER
6	0	xxxxxx1x	LINE DS1 – B NEAR HOURLY ALARMS EFS
6	0	xxxxx1xx	unused
6	0	xxxx1xxx	unused
6	0	xxx1xxxx	unused
6	0	xx1xxxxx	unused
6	0	x1xxxxxx	unused
6	0	1xxxxxxx	unused
6	1	xxxxxxx1	LINE DS1 – B NEAR DAILY ALARMS BER
6	1	xxxxxx1x	LINE DS1 – B NEAR DAILY ALARMS EFS
6	1	xxxxx1xx	unused
6	1	xxxx1xxx	unused
6	1	xxx1xxxx	unused
6	1	xx1xxxxx	unused
6	1	x1xxxxxx	unused
6	1	1xxxxxxx	unused
6	2	xxxxxxx1	LINE DS1 – B NEAR TOTAL ALARMS BER
6	2	xxxxxx1x	LINE DS1 – B NEAR TOTAL ALARMS EFS
6	2	xxxxx1xx	unused
6	2	xxxx1xxx	unused
6	2	xxx1xxxx	unused
6	2	xx1xxxxx	unused
6	2	x1xxxxxx	unused
6	2	1xxxxxxx	unused
6	3	xxxxxxx1	LINE DS1 – B FAR HOURLY ALARMS BER
6	3	xxxxxx1x	LINE DS1 – B FAR HOURLY ALARMS EFS
6	3	xxxxx1xx	unused
6	3	xxxx1xxx	unused
6	3	xxx1xxxx	unused
6	3	xx1xxxxx	unused
6	3	x1xxxxxx	unused
6	3	1xxxxxxx	unused
6	4	xxxxxxx1	LINE DS1 – B FAR DAILY ALARMS BER
6	4	xxxxxx1x	LINE DS1 – B FAR DAILY ALARMS EFS
6	4	xxxxx1xx	unused
6	4	xxxx1xxx	unused
6	4	xxx1xxxx	unused
6	4	xx1xxxxx	unused
6	4	x1xxxxxx	unused
6	4	1xxxxxxx	unused

6	5	xxxxxxx1	LINE DS1 – B FAR TOTAL ALARMS BER
6	5	xxxxxx1x	LINE DS1 – B FAR TOTAL ALARMS EFS
6	5	xxxxx1xx	unused
6	5	xxxx1xxx	unused
6	5	xxx1xxxx	unused
6	5	xx1xxxxx	unused
6	5	x1xxxxxx	unused
6	5	1xxxxxxx	unused
6	6	xxxxxxx1	LINE DS1 – B NEAR CURRENT ALARMS BER
6	6	xxxxxx1x	unused
6	6	xxxxx1xx	unused
6	6	xxxx1xxx	unused
6	6	xxx1xxxx	unused
6	6	xx1xxxxx	unused
6	6	x1xxxxxx	unused
6	6	1xxxxxxx	unused
6	7	xxxxxxx1	unused
6	7	xxxxx1xx	unused
6	7	xxxx1xxx	unused
6	7	xxx1xxxx	unused
6	7	xx1xxxxx	unused
6	7	x1xxxxxx	unused
6	7	1xxxxxxx	unused
7	0	xxxxxxx1	PATH DS1 – B NEAR HOURLY ALARMS BER
7	0	xxxxxx1x	PATH DS1 – B NEAR HOULRY ALARMS EFS
7	0	xxxxx1xx	unused
7	0	xxxx1xxx	unused
7	0	xxx1xxxx	unused
7	0	xx1xxxxx	unused
7	0	x1xxxxxx	unused
7	0	1xxxxxxx	unused
7	1	xxxxxxx1	PATH DS1 – B NEAR DAILY ALARMS BER
7	1	xxxxxx1x	PATH DS1 – B NEAR DAILY ALARMS EFS
7	1	xxxxx1xx	unused
7	1	xxxx1xxx	unused
7	1	xxx1xxxx	unused
7	1	xx1xxxxx	unused
7	1	x1xxxxxx	unused
7	1	1xxxxxxx	unused

7	2	xxxxxxx1	PATH DS1 – B NEAR TOTAL ALARMS BER
7	2	xxxxxx1x	PATH DS1 – B NEAR TOTAL ALARMS EFS
7	2	xxxxx1xx	unused
7	2	xxxx1xxx	unused
7	2	xxx1xxxx	unused
7	2	xx1xxxxx	unused
7	2	x1xxxxxx	unused
7	2	1xxxxxxx	unused
7	3	xxxxxxx1	PATH DS1 – B FAR HOURLY ALARMS BER
7	3	xxxxxx1x	PATH DS1 – B FAR HOURLY ALARMS EFS
7	3	xxxxx1xx	unused
7	3	xxxx1xxx	unused
7	3	xxx1xxxx	unused
7	3	xx1xxxxx	unused
7	3	x1xxxxxx	unused
7	3	1xxxxxxx	unused
7	4	xxxxxxx1	PATH DS1 – B FAR DAILY ALARMS BER
7	4	xxxxxx1x	PATH DS1 – B FAR DAILY ALARMS EFS
7	4	xxxxx1xx	unused
7	4	xxxx1xxx	unused
7	4	xxx1xxxx	unused
7	4	xx1xxxxx	unused
7	4	x1xxxxxx	unused
7	4	1xxxxxxx	unused
7	5	xxxxxxx1	PATH DS1 – B FAR TOTAL ALARMS BER
7	5	xxxxxx1x	PATH DS1 – B FAR TOTAL ALARMS EFS
7	5	xxxxx1xx	unused
7	5	xxxx1xxx	unused
7	5	xxx1xxxx	unused
7	5	xx1xxxxx	unused
7	5	x1xxxxxx	unused
7	5	1xxxxxxx	unused
7	6	xxxxxxx1	PATH DS1 – B NEAR CURRENT ALARMS BER
7	6	xxxxxx1x	unused
7	6	xxxxx1xx	unused
7	6	xxxx1xxx	unused
7	6	xxx1xxxx	DP Mask bit 0 (DM)
7	6	xx1xxxxx	DP Mask bit 1 (UAS)
7	6	x1xxxxxx	DP Mask bit 2 (SES)
7	6	1xxxxxxx	DP Mask bit 3 (ES)

7	7	xxxxxxx1	DP Mask bit 12 (TOTAL)
7	7	xxxxxx1x	DP Mask bit 13 (DAILY)
7	7	xxxxx1xx	DP Mask bit 14 (HOURLY)
7	7	xxxx1xxx	DP Mask bit 15 (CURRENT)
7	7	xxx1xxxx	DP Mask bit 16 (FAR)
7	7	xx1xxxxx	DP Mask bit 17 (NEAR)
7	7	x1xxxxxx	DP Mask bit 18 (PATH)
7	7	1xxxxxxx	DP Mask bit 19 (LINE)

Command	Code	Description
00	xx000000	toggle DP Mask bit 0 (DM)
01	xx000001	toggle DP Mask bit 1 (UAS)
02	xx000010	toggle DP Mask bit 2 (SES)
03	xx000011	toggle DP Mask bit 3 (ES)
04	xx000100	toggle DP Mask bit 4 (SFE)
05	xx000101	toggle DP Mask bit 5 (FE)
06	xx000110	toggle DP Mask bit 6 (OOF)
07	xx000111	toggle DP Mask bit 7 (CV)
08	xx001000	toggle DP Mask bit 8 (EFS)
09	xx001001	toggle DP Mask bit 9 (BER)
10	xx001010	toggle DP Mask bit 10 (DS1 – B)
11	xx001011	toggle DP Mask bit 11 (DS1 – A)
12	xx001100	toggle DP Mask bit 12 (TOTAL)
13	xx001101	toggle DP Mask bit 13 (DAILY)
14	xx001110	toggle DP Mask bit 14 (HOURLY)
15	xx001111	toggle DP Mask bit 15 (CURRENT)
16	xx010000	toggle DP Mask bit 16 (FAR)
17	xx010001	toggle DP Mask bit 17 (NEAR)
18	xx010010	toggle DP Mask bit 18 (PATH)
19	xx010011	toggle DP Mask bit 19 (LINE)
20	xx010100	unused
21	xx010101	unused
22	xx010110	unused
23	xx010111	unused
24	xx011000	unused
25	xx011001	unused
26	xx011010	unused
27	xx011011	unused
28	xx011100	unused
29	xx011101	unused
30	xx011110	unused

Command	Code	Description
31	xx011111	unused
32	xx100000	DS1 – A ACO On
33	xx100001	DS1 – A B8ZS Toggle
34	xx100010	DS1 – A Clock Toggle (INT->EXT->LOOP)
35	xx100011	DS1 – A Line Local Loopback Toggle
36	xx100100	DS1 – A Line Near Loopback Toggle
37	xx100101	DS1 – A Path Near Loopback Toggle
38	xx100110	DS1 – A Line Far Loopback Toggle
39	xx100111	DS1 – A Path Far Loopback Toggle
40	xx101000	DS2 – A Path Local Loopback Toggle
41	xx101001	unused
42	xx101010	unused
43	xx101011	unused
44	xx101100	unused
45	xx101101	unused
46	xx101110	unused
47	xx101111	unused
48	xx110000	DS1 – B ACO on
49	xx110001	DS1 – B B8ZS Toggle
50	xx110010	DS1 – B Clock Toggle (INT->EXT->LOOP)
51	xx110011	DS1 – B Line Local Loopback Toggle
52	xx110100	DS1 – B Line Near Loopback Toggle
53	xx110101	DS1 – B Path Near Loopback Toggle
54	xx110110	DS1 – B Line Far Loopback Toggle
55	xx110111	DS1 – B Path Far Loopback Toggle
56	xx111000	DS1 – B Path Local Loopback Toggle
57	xx111001	unused
58	xx111010	unused
59	xx111011	unused
60	xx111100	unused
61	xx111101	unused
62	xx111110	PERFORMANCE RESET
63	xx111111	RPIU Reset

The user can send commands to the RPIU using the following TBOS command format:

(a) Send command opening byte: "0100 0000" (40h).

(b) Send the actual command: "10xx xxxx" where x is specified in the preceding TBOS table.

(c) Send command closing byte: "1100 1100" (cch).

7. GLOSSARY OF ACRONYMS AND TERMS

AIS (ALARM INDICATION SIGNAL): An unframed all ones pattern which is transmitted in a *downstream* DS1 link when a red alarm has been detected in an *upstream* link. AIS must maintain a ones density of 99.9% (to allow for a bit error rate of 10e – 3). AIS transmission destroys the ESF data link. It also contributes to the Unavailable Seconds calculation. In the 9004B, AIS is detected within the Transmit/Receive card hardware.

BER (BIT ERROR RATE): The ratio of Coding Violations (CV) to the total number of bits received during the period specified. For HOURLY, DAILY, and TOTAL BER, unavailable time is removed from the BER elapsed time. BER is a general quality of service indicator.

CV (CODING VIOLATIONS): LINE CVs are based on line formats and signal characteristics, such as bipolar violations. PATH CVs are based on path formats, such as CRC – 6 errors. The RPIU accumulates raw counts of both bipolar violation and CRC – 6 errors and then uses these to compute other Performance Monitor (PM) parameters.

DM (DEGRADED MINUTE): Available time, with all Severely Errored Seconds (SESs) removed and containing 93 or more CRC – 6 errors.

EFS (ERROR-FREE SECONDS): Ratio expressed as the number of seconds containing errors, that is, either Errored Seconds (ES) or Unavailable Seconds (UAS), divided by the total number of elapsed seconds. EFS is expressed as a percentage; for example, an Error-Free Seconds value of 100 represents 100%, or perfect error-free transmission. A value of 0 represents the worst case. EFS is a general quality of service indicator.

ES (ERRORED SECOND): If during a one second interval at least one Coding Violation (CV), controlled slip, or Out of Frame error occurs, an Errored Second is declared. LINE Errored Seconds are based only on bipolar violations. PATH Errored Seconds are based on CRC errors and Out of Frame (OOF) events.

FE (FRAMING ERROR): The error received when exactly one of the received framing bits is in error. When more than one is in error, a Severe Framing Error (SFE) is declared.

LINE: A line is a physical connection that provides a means of moving information between two consecutive Network Elements (NEs), one of them originating the line signal and one of them terminating the line signal. A line is characterized by a single transmission technology operating at a single bit rate. A line parameter can be thought of as a parameter that reflects the transmission quality of a point-to-point physical connection.

LOF (LOSS OF FRAME): Loss of Frame is declared when OOF lasts long enough (2.5 ± 0.5 seconds) to cause a Carrier Failure Alarm (CFA) to be declared.

LOS (LOSS OF SIGNAL): Loss of Signal is declared after 175 ± 75 contiguous zeros (no pulses) have been detected in the incoming signal. LOS is utilized in the computation of UAS. LOS is detected in the Transmit/Receive card of the 9004B.

LOOPBACK: For the 9004 system, three common types of loopback exist. LINE LOCAL loopback entails looping of the near-end transmit DS1 signal to the near-end receivers. PATH LOCAL entails looping the near-end transmit of the framer to the near-end receive of the framer. PATH (Payload) loopback occurs when the 192 information (or payload) bits of each frame, which are received at the near-end, are looped back to the far-end while the F-bits (framing, CRC – 6 or data link) are generated by the near-end terminal which is being looped back. LINE (Remote) loopback occurs when not only the 192 information bits, but the F-bits too, are looped back to the far-end. From a given 9004 terminal, these four types of loopback can be implemented locally, in addition to requesting that the latter two types of loopback be implemented remotely, yielding a total of 6 loopback request types. For more information on Loopback, see Practice 342-911-133.

OOF (OUT OF FRAME): PATH parameter which indicates that a framing problem occurred. The number of one second intervals since the system was reset during which at least one Severe Framing Error (SFE) occurred.

PATH: A path is connected between two points independent of the equipment and media providing the physical means of transporting the signal, which provides digital signal transport at a specified rate. A path parameter reflects the end-to-end quality of a connection. Typical path parameters are CRC code violations and Framing errors.

PM (PERFORMANCE MONITORING): Performance Monitoring in general refers to the task of collecting information about the quality of transmission between the two network elements.

PRM (PERFORMANCE REPORT MESSAGE): A single, unnumbered and unacknowledged LAPD frame which contains bit-mapped information related to CRC error performance, framing error events, line code violations, controlled slips and payload loopback. The terminal receiving the DS1 signal (sink terminal) transmits the PRM over the ESF data link back to the source terminal originating the DS1 signal. The function of the message is to inform the source terminal of transmission errors received at the sink terminal over the DS1 facility between them. In this way, a PRM transmitted in one direction indicates the quality of transmission in the other direction. A terminal is responsible for transmitting a PRM once every second.

SES (SEVERELY ERRORED SECOND): LINE or PATH parameter indicating a second with a Bit Error Rate worse than 10E – 03. For LINE Severely Errored Seconds this implies a second with 1544 or more bipolar violations. For PATH Severely Errored Seconds this implies a second with at least 330 CRC – 6 errors. An Out Of Frame (OOF) event within a one

second interval also constitutes a Severely Errored Second. PATH SES is not increased during unavailable time.

SFE (SEVERE FRAMING ERROR): The error received when more than one of the received framing bits is in error. When exactly one is in error, a Framing Error (FE) is declared.

TREU (TRANSMIT/RECEIVE ESF UNIT): The RPIU is designed to work with two TREUs per 9004 product; one for each DS1 digroup. The TREUs provide the network interfaces to the 9004 at the DS1 rate (DS1 Superframe or Extended Superframe format).

RPIU (REMOTE PERFORMANCE INTERFACE UNIT): The RPIU is a replacement for the Office Interface Unit (OIU) for the 9004 product which provides many new features, including extensive Performance Monitoring capabilities, RS-232 and RS-422 interfaces, and remotely configurable options.

UAS (UNAVAILABLE SECONDS): Service becomes unavailable during conditions such as Loss Of Signal (LOS), Loss Of Frame (LOF) events, or at the onset of 10 consecutive PATH Severely Errored Seconds (SESs). UAS is increased each second service is interrupted by any of these conditions. Once service is declared unavailable due to Severely Errored Seconds, it can only become available again at the onset of 10 consecutive seconds without a PATH Severely Errored Second. This means that when 11 SESs occur followed by 10 Error-Free Seconds, the following statistics are gathered:

(a) The first 10 Severely Errored Seconds increase the SES and ES counter 10 times.

(b) At the onset of the tenth SES, service is declared unavailable. The UAS counter is increased and both the SES and ES are decreased 10 seconds. The SES and ES counters are not increased further until time becomes available.

(c) The system continues increasing the UAS counter until 10 seconds elapse without an SES.

(d) During this time period, the RPIU tracks any ESs that occur but does not add them to the ES counter.

(e) If the next 10 seconds elapse without an SES, service is declared available again. The system then decreases the UAS counter by 10, and adds any ESs to the ES counter that were measured during the 10 seconds without an SES occurrence.

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Section 342-911-050
Issue 2, August 1989

9004 AND TRANSLINK SYSTEMS

FCC Requirements for the 9004A, 9004B, Translink I, and Translink II Systems

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As the electronics industry uses lower power and higher-density equipment packages, the components have become more and more susceptible to damage from electrostatic discharge. In such cases, Siemens Transmission Systems, Inc. designs the equipment to minimize the possibility of failure resulting from electrostatic discharge. The units and their shipping containers are marked with the Electronic Industries Association (EIA) symbol (see below) for electrostatic-discharge-sensitive devices. For enclosed units, the case as well as the card is identified with the EIA symbol. Handle these units according to your company's procedures or refer to Section 300-000-001.

EIA Symbol

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1. INTRODUCTION

1.01 This section provides Federal Communications Commission (FCC) information for the 9004A, 9004B, TRANSLINK I, and TRANSLINK II systems, when used as customer-premises equipment.

1.02 This section is revised to add all FCC Part 68 registered channel units to Table 1. Remove the previous issue of this section from the binder or microfiche file and replace it with this issue.

2. FCC REQUIREMENTS - PART 68

2.01 The 9004A, 9004B, TRANSLINK I, and TRANSLINK II systems comply with Part 68 of the FCC Rules. In general, terminal equipment directly connected either to the public switched telephone network or to private line services (defined in FCC Part 68.2 [a]) that are extended over public facilities must be FCC Part 68 registered.

2.02 On the shelf or side of the equipment enclosure is a label that contains, among other information, the FCC Registration Number (F6P392-19519-XD-N) and Ringer Equivalence Number (REN) for this equipment. (The TRANSLINK I utilizes an FCC Part 68 registered Kentrox Customer Service Unit [CSU] for network T1 interfaces [FCC Registration Number F814HV-16308-DE-N]). Specific information for the various registered network interfaces is shown in Tables 1 and 2. If you connect the equipment to the telephone network, you must provide this information on a per-line basis upon request by the telephone company. If you intend to connect to Off-Premises Station (OPS) facilities, you must inform the telephone company of the OPS class for which the equipment is registered. (OPS class information is contained in the Facility Interface Code in Table 1.)

2.03 The REN is useful to determine the quantity of devices you may connect to your telephone line and still have all of those devices ring when your number is called. In most, but not all, areas, the sum of the RENs of all devices should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should call your local telephone company to determine the maximum REN for your calling area.

2.04 If you have 1.544-Mb/s service or facilities provided by the telephone company, you must notify the telephone company before you disconnect the equipment from the telephone network.

2.05 If problems are encountered with the 9004A, 9004B, TRANSLINK I, or TRANSLINK II system, you must disconnect it from the telephone line to determine if it is malfunctioning. If it is found to be malfunctioning, do not return it to service until the problem has been corrected.

2.06 If the equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. They will notify you in advance when practical, but if advance notice is impractical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

2.07 In the event that repairs are required on the equipment, they should be performed by Siemens Transmission Systems, Inc. or an authorized representative of Siemens Transmission Systems, Inc. Failed units should be tagged, with the defect or problem identified, and sent to Siemens Transmission Systems, Inc., One Camino de Lenkurt, N.E., Albuquerque, New Mexico 87123. For technical assistance or after-hours emergency support, contact Siemens Transmission Systems, Inc. Technical Services at (800) 255-1315 or (602) 395-5000. Normal business hours are 7:30 AM to 4:00 PM Mountain Standard Time.

Telephone Company Procedures

2.08 Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.

2.09 This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

Installation Requirements

2.10 When the equipment is used as registered terminal equipment and directly connected to the telephone network, all systems premises wiring between the equipment and the telephone network shall be "fully protected" as defined in FCC Part 68, Section 68.3. In part, systems premises wiring is wiring that connects an equipment entity or system component with the telephone network interface. System premises wiring is located on the customer's premises and not within an equipment housing. This wiring, if it is "fully protected" wiring, will consist of one of the following:

(a) A connectorized cord, not longer than 50 feet in total length either as an integral length or in combination with no more than one connectorized extension cord (refer to FCC Part 68, Section 68.200 [h]).

(b) Wiring in an equipment room with restricted access, provided that this wiring remains exposed for inspection and is not concealed or embedded in the building's structure, and that it conforms to FCC Part 68, Section 68.215 (d).

(c) Wiring which is electrically behind FCC Part 68 registered (or grandfathered) equipment, system components, or protective circuitry that ensures that electrical contact between the wiring and commercial power wiring or earth ground will not result in hazardous voltages or excessive longitudinal imbalance at the telephone network interface.

2.11 Alternately, if the system wiring is installed as unprotected system premises wiring, then the requirements of FCC Part 68, Section 68.215 are applicable, including the filing of a wiring affidavit as required therein.

2.12 The 9004A, 9004B, TRANSLINK I, and TRANSLINK II systems have been registered as XD[1] equipment. Use of an FCC Part 68 registered CSU is required when interfacing the telephone network with the T1 port of the 9004A, 9004B, or TRANSLINK II systems. The TRANSLINK I system utilizes FCC Part 68 registered CSU equipment internally for T1 interfaces.

Jacks

2.13 Any jack configurations specified in Table 1 used singly, in multiple combinations, or combined in common mechanical arrays, may be used as the interface between multiline equipment and the telephone network. If a jack such as Universal Service Order Code (USOC) RJ2HX is specified (eight terminals per position), and if a particular interface uses a lesser number of terminals per position (e.g., a two-wire FXS circuit uses two terminals), then the unused terminals for a given position may not be utilized in a mixed application. The telephone company and installation supervisor may mutually agree to use jacks other than those specified in Table 1.

NOTE: Technical references which illustrate allowable mix and match configurations are listed at the end of the FCC document entitled "Instructions for Completing Form 730."

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[1] XD is a system registration code for FCC Part 68 registered Digital Network Equipment (multiplexers and channel banks that connect to the telephone network through FCC Part 68 registered CSUs).

Table 1. Analog Registered Network Interfaces.

CIRCUIT	TYPE OF INTERFACE	E&M INFORMATION		USOC JACK*	REN/ SERVICE CODE	NUMBER OF LEADS	FACILITY INTERFACE CODE
		TYPE	SIDE				
91408-01	2-Wire Ground	--	--	RJ21X	2.3B	2	02GS2
91458-11	2-Wire Ground	--	--	RJ21X	1.8B	2	02GS2
91402-01 91402-02 91402-03 91452-11 91452-12	2-Wire E&M	I	B	RJ2EX	9.0F	4	TL11E
91402-01 91402-02 91402-03 91452-11 91452-12	2-Wire E&M	II	B	RJ2FX	9.0F	6	TL12E
91404-01 91404-02 91454-11	4-Wire E&M	I	B	RJ2GX	9.0F	6	TL31E
91404-01 91404-02 91454-11	4-Wire E&M	II	B	RJ2HX	9.0F	8	TL32E
91409-01 91459-11	FXS	--	--	RJ21X	9.0F	2	0L13C
91409-02 91417-11 91459-12	FXS	--	--	RJ11C or RJ21X	9.0F	2	0L13C
91459-12	PLAR	--	--	RJ11C or RJ21X	9.0F	2	02AC2 or 02AC3
91479-11	PLAR	--	--	RJ1DC or RJ2DX	9.0F	2	04AC2
91401-01 91451-11 91451-12	PLAR	--	--	RJ1DC or RJ2DX	9.0F	4	04NO2

*The RJ2HX and other jacks specified in the table may be used in combination with other jacks.

Table 2. Digital Registered Network Interfaces.

CIRCUIT	TYPE OF INTERFACE (DIGITAL FIC)	USOC JACK	REN/ SERVICE CODE	NUMBER OF LEADS	FACILITY INTERFACE CODE
91438-01 91439-01 (9004B & TRANSLINK II)	N/A	N/A	6.0P	N/A	N/A
91438-01 91439-01 (TRANSLINK I)	N/A *	N/A	6.0P	N/A	N/A
91423-01 91433-01 (9004A)	N/A	N/A	6.0P	N/A	N/A

*The TRANSLINK I system utilizes an FCC Part 68 registered CSU (Kentrox FCC Registration Number F814HV-16308-DE-N) internally for direct connection of the T1 lines to the telephone network.

Signal Power Limitation

2.14 FCC Part 68, Section 68.308 specifies and measures absolute power levels relative to a zero Test Level Point (0TLP) reference (0dBm). Analog port interfaces used with this equipment may use other than a 0TLP (0dBm) reference and the absolute power level of the signal from these analog ports will be shifted either upward (higher) or downward (lower) relative to the assumed zero reference.

2.15 Although not intended for direct access to the telephone network, these analog ports could be applied in a registered application, and without proper treatment, they could exceed the specified signal power levels. One example could be a four-wire E&M signaling analog port with a +7 dB receive and a −16 dB transmit TLP.

2.16 Commonly used in network switching applications as a carrier interface port, this port could also be connected to a facility and could exceed the signal power levels specified in FCC Part 68 for registered applications.

2.17 If the level is adjusted (in this case, a 7-dB pad on the +7 dB receive port), the adjusted port would then comply with the required signal power level objectives.

2.18 The 9004A, 9004B, TRANSLINK I, and TRANSLINK II systems provide all protection except signal power limiting. FCC requirements limit this service code of equipment to be used only with FCC Part 68 registered equipment.

Ringing Generator Requirements for Off-Premises Extensions

2.19 Ringing generator requirements for Off-Premises Extensions (OPXs) of registered terminal equipment are limited by the FCC to 200V peak-to-ground and 300V peak-to-peak. To ensure that this requirement is met, ringing generators that supply OPXs should be adjusted for a voltage output of 95 Vrms. The maximum voltage, under any condition of operation, should not exceed 100 Vrms for registered terminal equipment OPX applications. When properly adjusted, the Warren ringing generator (Siemens Transmission Systems, Inc. part number 190-56700-01), meets the above requirements.

3. FCC PART 15 - USER'S INFORMATION

Translink I and Translink II Systems

3.01 The TRANSLINK I and TRANSLINK II systems are intended for use in customer-premises applications. Changes or modifications to the equipment not expressly approved by Siemens Transmission Systems, Inc. could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

9004A and 9004B Systems

3.02 **91400-01 and 91430-01 Channel Bank Shelves.** The 9004A (91400-01 Channel Bank Shelf) and 9004B (91430-01 Channel Bank Shelf) systems will comply with the requirements of Part 15 of the FCC Rules for a Class A computing device if cable installation kit 970-91400-01 (9004A) or 970-91430-01 (9004B) is utilized during the installation of the system. It is the responsibility of the installer to provide and install the required cable installation kit. Changes or modifications to the equipment not expressly approved by Siemens Transmission Systems, Inc. could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

3.03 The 91430-11 Channel Bank Shelf (9004B) and Channel Bank Shelves 91400-01 and 91430-01 without their respective cable installation kits are intended for sale or lease only to public utilities and to U.S. Government agencies and do not necessarily comply with the technical requirements of FCC Part 15. This equipment shall not be resold except for use by a public utility or government agency. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user will be required to correct the interference at his own expense.

USER RESPONSE / REQUEST FORM

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CHANGE NOTICE SUMMARY

Revision	Reason for Change	Date of Change